ARMY AIR FORCES
TECHNICAL ORDER No. 08-10-158

INSTRUCTION BOOK

FOR

OPERATION AND MAINTENANCE

OF

RADIO SET SCR-AS-183

RESTRICTED

PUBLISHED BY AUTHORITY
OF
THE CHIEF SIGNAL OFFICER

FOR AIRPLANE TYPE _____
AAF SERIAL NO._____

APRIL 3, 1943

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TECHNICAL ORDER No. 08-10-158

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APRIL 3, 1943

REPORT OF MAJOR FAILURE

IN THE EVENT OF MAJOR FAILURE OF ANY OF THE COMPONENT UNITS OF THIS EQUIPMENT, A REPORT SHALL BE SUBMITTED IN THE FORM INDICATED BELOW.

COPIES OF THIS REPORT SHALL BE FORWARDED TO THE CHIEF, SIGNAL SECTION, AIR SERVICE COMMAND, PATTERSON FIELD, FAIRFIELD, OHIO, AND TO THE DIRECTOR, SIGNAL CORPS AIRCRAFT SIGNAL SERVICE, WRIGHT FIELD, OHIO.

1. Contract or order number.
2. Organization and station.
3. Nomenclature of equipment.
4. Nomenclature of component unit.
5. Date and nature of failure.
6. Type of airplane in which installed.
7. Recommendations.

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SAFETY NOTICE

OPERATING OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY PRECAUTIONS. DO NOT DISCONNECT ANY CABLES OR OPEN ANY UNITS UNLESS ALL SWITCHES ARE IN THE OFF POSITION.

THE PROPER SEQUENCE FOR SETTING THE EQUIPMENT IN OPERATION IS OUTLINED HEREIN. DO NOT ATTEMPT TO OPERATE THE EQUIPMENT WITHOUT FIRST HAVING READ THIS MANUAL COMPLETELY AND EVEN THEN ONLY WHEN THE INSTRUCTIONS ARE FOLLOWED EXACTLY.

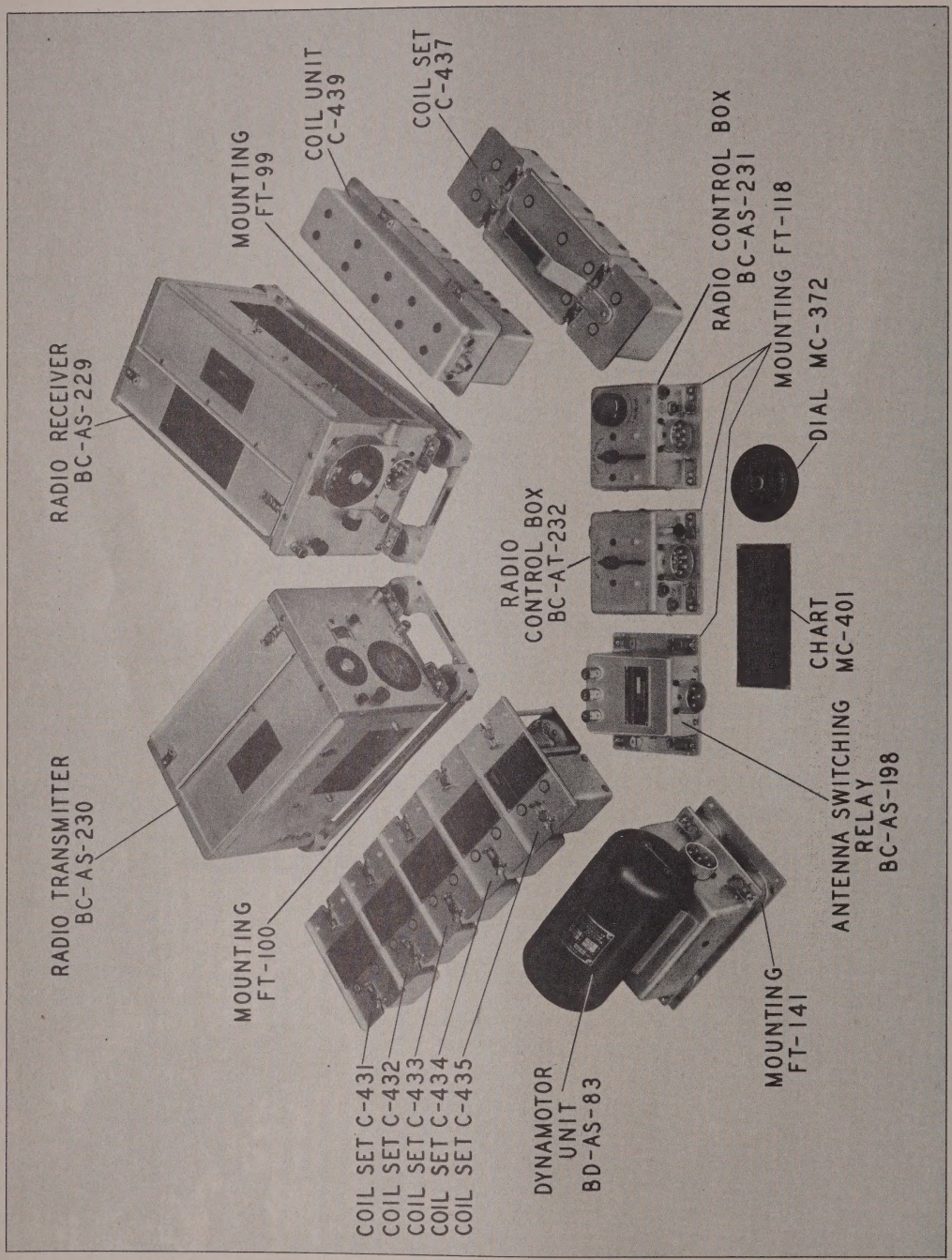

FIGURE 1—RADIO SET SCR-AS-183, PRINCIPAL COMPONENTS

INSTRUCTION BOOK
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SECTION I
DESCRIPTION

1. GENERAL

Radio Set SCR-AS-183 is intended for installation and operation in aircraft having 12-14.25 volt d-c power supply systems. Radio Set SCR-AS-183 is primarily used for single-seated planes and provides communication from ship to ship or from ground to plane over limited distances, approximately 15 or 20 miles for modulated transmission. Radio Set SCR-AS-183 is used to receive modulated or damped-wave signals at any frequency range mentioned below.

The frequency ranges of Radio Receiver BC-AS-229 are 201 to 398 kilocycles and 2,500 to 7,850 kilocycles. The frequency range of Radio Transmitter BC-AS-230 is 2,500 to 7,700 kilocycles. At any frequency within this range it is used to transmit unmodulated, tone-modulated, or voice-modulated signals.

2. COMPONENT PARTS

All of the component units listed are irregular in shape; their significant dimensions are given in the following chart.

Component Parts	*Weight (pounds)*	*Height (inches)*	*Depth (inches)*	*Width (inches)*
Antenna Swiching Relay BC-AS-198 (includes Mounting FT-118)	1.1	2¾	4	4⅝
Chart MC-401 (for cockpit)	0.1			
Coil Set C-431 (transmitting 2,500-3,200 kc)	0.9	3½	3 3/16	5½
Coil Set C-432 (transmitting 3,200-4,000 kc)	0.9	3½	3 3/16	5½
Coil Set C-433 (transmitting 4,000-5,000 kc)	0.9	3½	3 3/16	5½
Coil Set C-434 (transmitting 5,000-6,200 kc)	0.9	3½	3 3/16	5½
Coil Set C-435 (transmitting 6,200-7,700 kc)	0.9	3½	3 3/16	5½
Coil Set C-436 (receiving 2,500-4,700 kc)	1.75	3⅜	3 15/16	11⅛
Coil Set C-437 (receiving 4.150-7,850 kc)	1.75	3⅜	3 15/16	11⅛
Coil Unit C-439 (Dual, Rec. 201-398 kc and 2,500-4,700 kc)	2.9	3½	11⅝	4 15/16
Coil Unit C-440 (Dual, Rec. 201-398 kc and 4,150-7,700 kc)	2.9	3½	11⅝	4 15/16
Dial MC-372 (0-100 div., 201-398 and 2,500-4,700 kc clockwise)	0.07			
Dial MC-390 (0-100 div., 201-398 and 4,150-7,700 kc clockwise)	0.07			

Component Parts	*Weight (pounds)*	*Height (inches)*	*Depth (inches)*	*Width (inches)*
Dynamotor Unit BD-AS-83, includes Mounting FT-141	9.9	7 1/16	7 3/8	4 3/8
Radio Receiver BC-AS-229 (includes Mounting FT-99)	12.0	7 5/8	15 11/16	6 1/2
Radio Control Box BC-AS-231 (receiving), includes Mounting FT-118	0.9	2 7/16	4 5/8	4
Radio Control Box BC-AT-232 (transmitting), includes Mounting FT-118	0.9	2 7/16	4 5/8	4
Radio Transmitter BC-AS-230 (includes Mounting FT-100)	10.2	7 5/8	13 1/4	6 5/8

Complete set of Vacuum Tubes Consists of:

2 Tube VT-25-A (for transmitter)
2 Tube VT-52 (for transmitter)
1 Tube VT-37 (for receiver)
1 Tube VT-38 (for receiver)
4 Tube VT-49 (for receiver)

The total weight of Radio Set SCR-AS-183 is 39.04 lbs., exclusive of the cables.

3. ADDITIONAL EQUIPMENT REQUIRED

The following standard parts, not supplied with this order, are the minimum additional parts required for operation of Radio Set SCR-AS-183.

Antenna Wire
Cord and Plugs
Cord CD-307 or Cord CD-307-A (Headset extension)

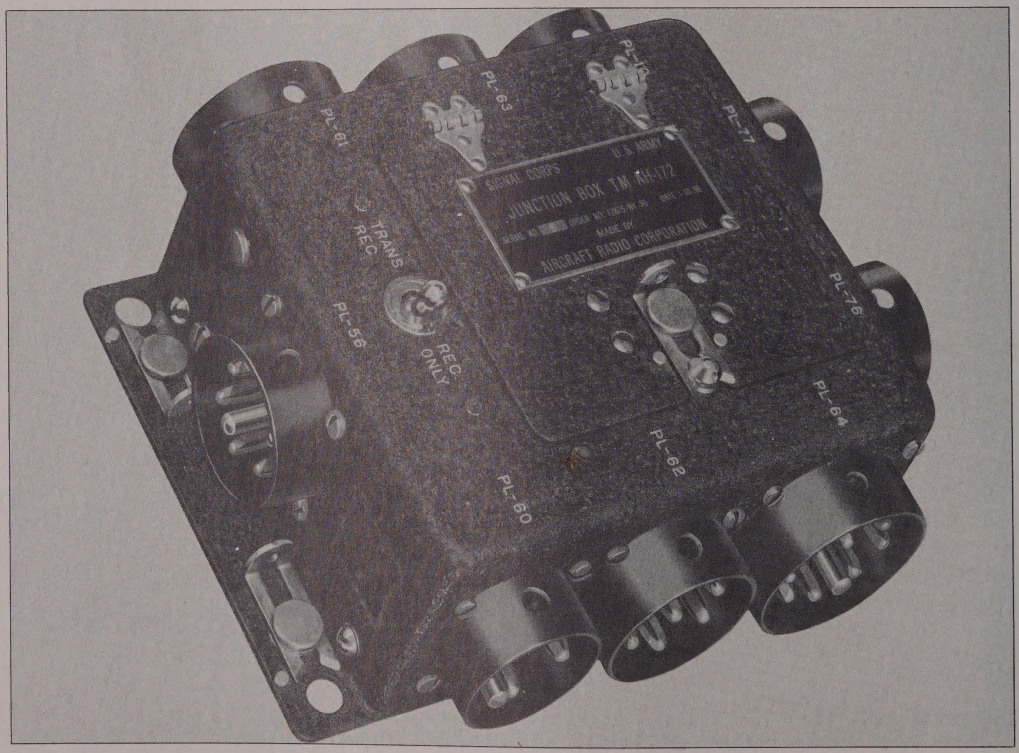


FIGURE 2—JUNCTION BOX TM-AH-172 (NOT FURNISHED AS PART OF SCR-AS-183 EQUIPMENT)

Headset HS-18 or Headset HS-23

Insulators

Junction Box (furnished by airplane contractor as part of the airplane) or equivalent circuits

Microphone T-17 or Microphone T-20-A with Microphone Amplifying Equipment RC 19-A

Tuning Unit MC-125 (remote)

Test Set I-56-A is recommended for use in the maintenance of Radio Set SCR-AS-183.

4. POWER CONSUMPTION

Radio Set SCR-AS-183 consumes 150 watts as supplied from the airplane.

5. DESCRIPTION OF PRINCIPAL COMPONENTS

a. Radio Receiver BC-AS-229

Radio Receiver BC-AS-229 is contained in a setbox which includes the supply and coupling circuits, tube sockets, power terminals and plug-in coil terminals, required for the reception of radio signals. It is shown together with Mounting FT-99 and Coil Set C-437 in Figure 3.

Mounting FT-99 consists of a metal frame with a shock-proof cup assembly 253 at each corner. Four snapslides on mounting brackets 284 on the receiver engage the four studs 271 which are molded in the soft rubber of the shock-proof cup assemblies.

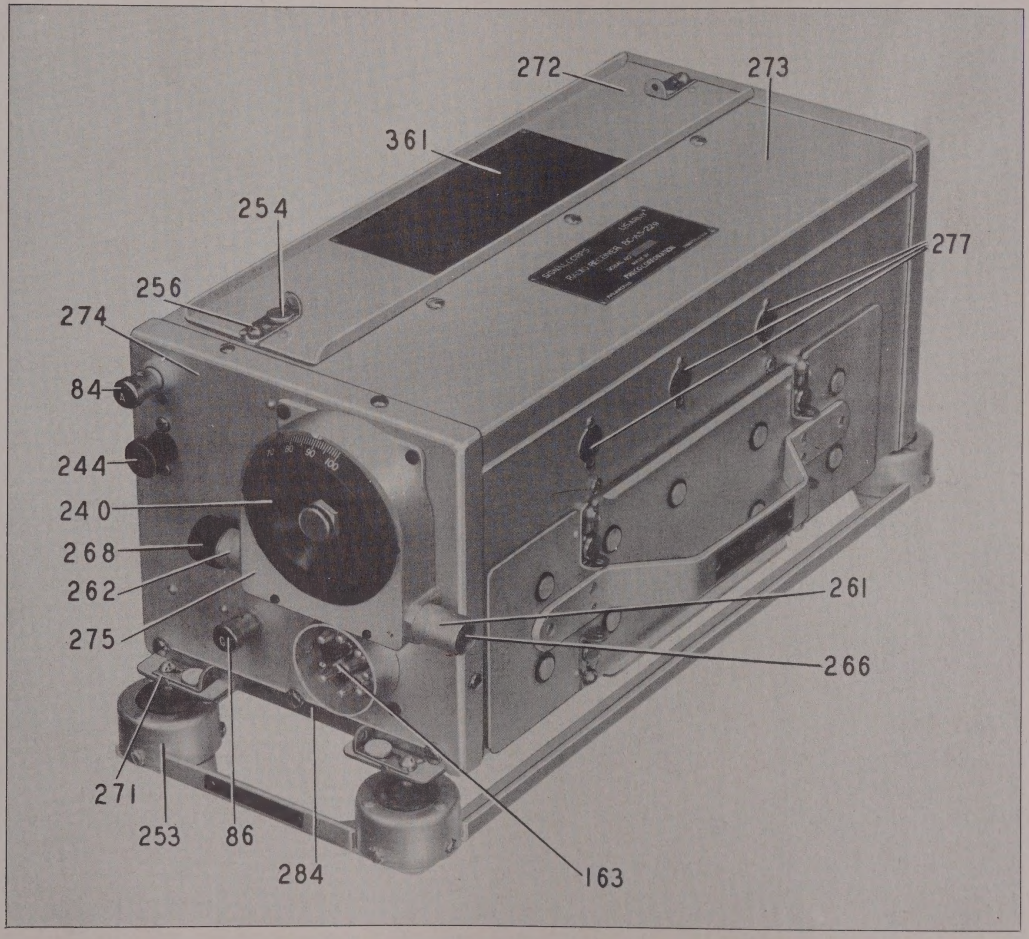


FIGURE 3—RADIO RECEIVER BC-AS-229 WITH COIL SET C-437 IN PLACE

PAR. 5

The receiver case 273 is of riveted aluminum having one end blanked and the other end open. It has an opening in one side for the coil set and a second opening in the top (closed by tube cover 272) which allows access to the tubes. The open end of the setbox is closed by a metal panel 274 on which are mounted:

Antenna binding post 84
Ground binding post 86
Input alignment condenser 80 and its adjusting knob 244
Dial gear unit 275
Receiver dial 240
Power plug receptacle 163.

The internal frame or chassis of the receiver is permanently attached to the front panel 274. The case is attached to the front panel and various other points of the receiver and forms, together with the front panel, a complete shield closure for the receiver. Tube cover 272 is secured to the setbox by two snapslides 254. The tube compartment is divided into cells by the tube shields 276 which serve to reduce the capacity coupling between the tuned stages of the radio-frequency amplifier.

b. Radio Control Box BC-AS-231

Radio Control Box BC-AS-231 is a remote control unit carrying a switch, control resistors, and telephone receiver jacks. It is designed for remote control of the electrical power and amplification circuits of the receiver. The switch has a center position OFF, a side position MANUAL, and a second side position AUTO. Both the side positions are operating positions. See Figure 7.

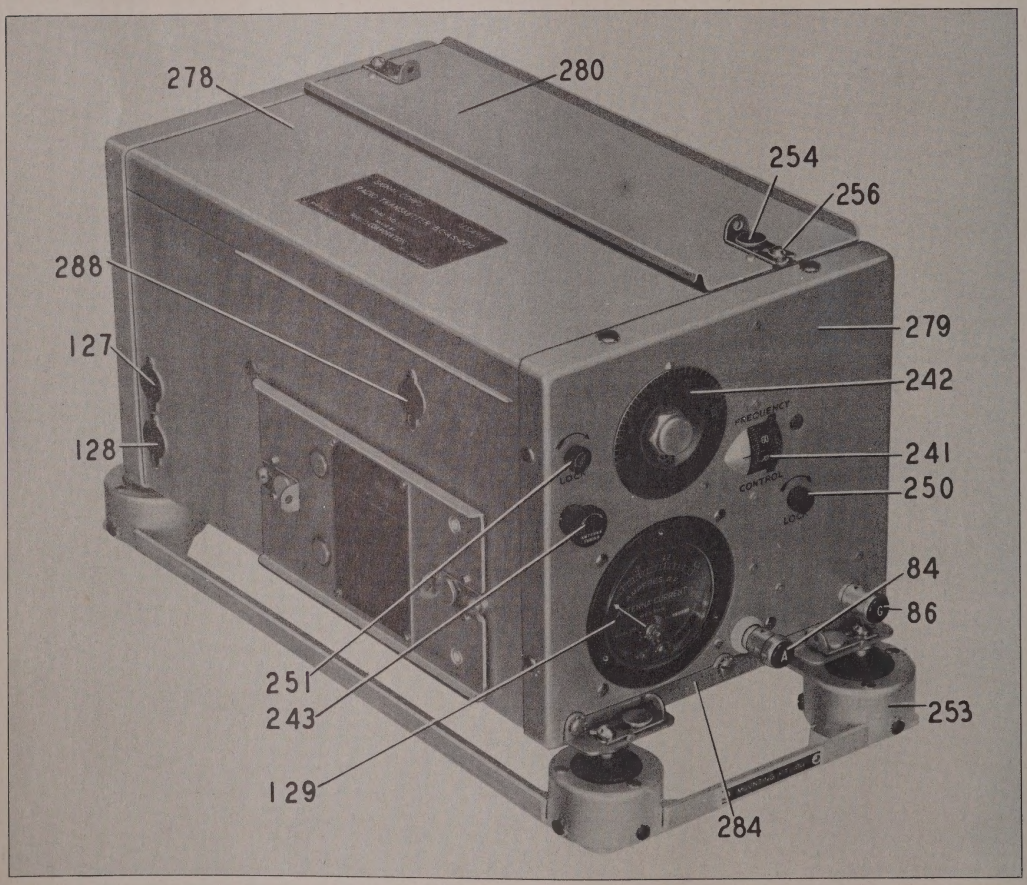


FIGURE 4—RADIO TRANSMITTER BC-AS-230 WITH COIL SET C-435 IN PLACE

c. Radio Transmitter BC-AS-230

Radio Transmitter BC-AS-230 is contained in a setbox which includes the circuits and tuning elements required for the generation, amplification and modulation of radio-frequency currents.

The transmitter case 278 is a riveted aluminum case having an opening in one end for the power plug and the other end entirely open. It has an opening in one side for the coil set. A second opening in the top is closed by tube cover 280.

The open end of the case is closed by metal panel 279 on which are mounted:

Antenna and ground
binding posts 84 and 86
Frequency control knob 241
Dial 242
Antenna condenser knob 243
Locking knobs 250, 251
Antenna current ammeter 129

The internal frame or chassis of Radio Transmitter BC-AS-230 is permanently attached to panel 279. The case, attached to this panel and various other points of the chassis, forms (together with the panel) a complete shielding closure for the transmitter. The tube cover 280 is attached to the case by two snapslides 254.

d. Radio Control Box BC-AT-232

Radio Control Box BC-AT-232 is a small unit primarily identified with the control of Radio Transmitter BC-AS-230. It carries a selector switch 263, a telegraph key 140, and a jack 138 for use in modulating the transmitter from either a microphone or other external source. Radio Control Box BC-AT-232 carries, besides the telegraph key, one Switch 141 manually operated by handle 263 which selects the type of emission from the transmitter. It has a center position CW, a side position TONE, and a second side position VOICE.

e. Coil Set C-436 and Coil Set C-437

Each of the receiver coil sets consists of an assembly of shielded, plug-in, radio-frequency transformers (one transformer 89, three transformers 90) and a shielded, band-pass coil assembly 92. Each coil set is identified by a certain frequency range, which is the range throughout which the receiver can be continuously tuned, when that coil set is mounted in the receiver. Tuning is accomplished by rotating the tuning capacitor between its maximum and minimum positions indicated respectively by the end-points 0 and 100 on the tuning dial 240.

The receiver dial 240 is graduated in equal divisions from 0 to 100, increasing numbers corresponding to increasing frequency on any coil set. Increments in frequency in any band are proportional to increments in dial setting. Coil sets of all types are plugged into the receiver at the side, as indicated in Figure 3 and secured by snap slides 254 at four points.

Coil Unit C-439 is a combination of two coil sets with the necessary built-in switches to switch from

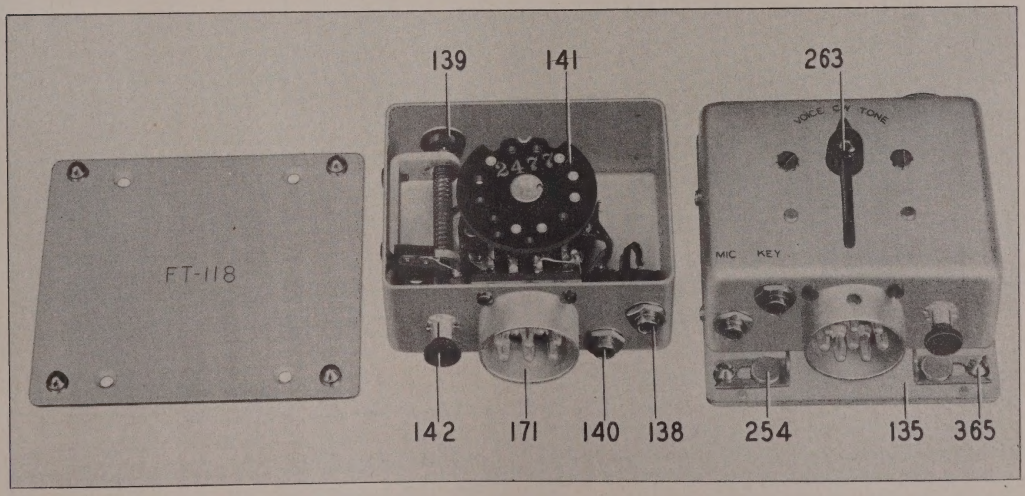


FIGURE 5—RADIO CONTROL BOX BC-AT-232 (TRANSMITTING)

one set to the other. Coil Unit C-439 is shown in Figure 10. The high-frequency band of this coil unit is 2,500-4,700 kc and the low-frequency band is 201-398 kc.

f. Coil Sets C-431, C-432, C-433, C-434 and C-435

The operating frequency band of Radio Transmitter BC-AS-230 is determined by the transmitter coil set. Each of these coil sets is a demountable unit similar in function to the receiver coil sets, and attached in the transmitter by snapslides. The transmitter coil set includes the oscillator coil assembly 122 and an antenna coil assembly 121. The antenna coil assembly is connected to the antenna through an adjustable slide tap 130. The frequency calibration for each coil set is shown on a plate mounted on the coil set. The calibration for each coil set applies only to the transmitter bearing the same serial number as that coil set.

Mounting FT-100 is similar to Mounting FT-99 for Radio Receiver BC-AS-229 except for the dimensions of the frame. It is provided with shockproof mounting cups 253 having snapslides studs to which the transmitter is secured by four snapslides on mounting brackets 284.

g. Dynamotor Unit BD-AS-83

Dynamotor Unit BD-AS-83 consists of a dynamotor machine mounted on a box containing a filter circuit and a voltage divider.

Dynamotor Unit BD-AS-83 is shown in Figure 1 and an interior view in Figure 8.

The dynamotor is of the totally enclosed type, having a low-voltage commutator and brushes at one end, with a high-voltage commutator and brushes at the other end. Current is fed to the low-voltage commutator and to the common field winding from the 12-14.25 volt d-c source. Current is drawn from the high-voltage commutator at 300-375 volts, depending upon the value of the input voltage. Four leads pass from the machine into the box, two serving as low-voltage input leads to the machine and two as high-voltage output leads from the machine. See Paragraph 16.

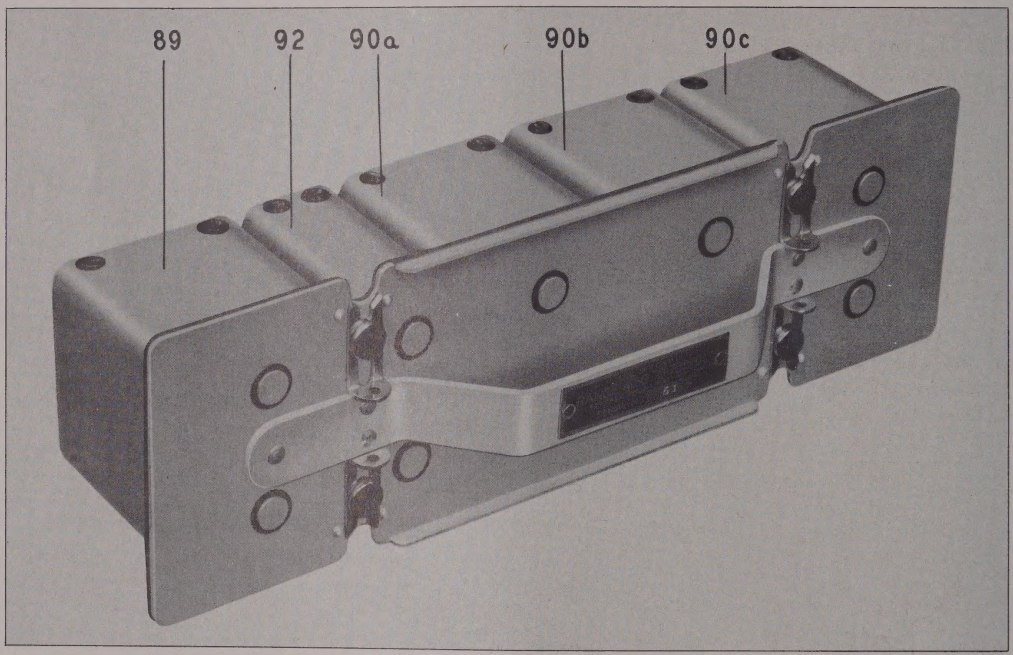


FIGURE 6—COIL SET C-437 (RECEIVING)

Mounting FT-141 is a shock-proofed base plate having studs 365 to which the dynamotor is attached by means of snapslides. The interior of the unit is protected, when it is not attached to the mounting, by Sub-base M-158 (246), which is screwed to the filter box at three points.

h. Antenna Switching Relay BC-AS-198

Antenna Switching Relay BC-AS-198 is shown in Figure 9. It is a disposable unit containing a two-position relay, an antenna binding post (ANT.) and two binding posts for connection to the antenna terminals of receiver (REC.) and transmitter (TR.) respectively. It also carries a receptacle for Plug PL-77.

i. Chart MC-401

Two Charts MC-401 are furnished with each Radio Receiver BC-AS-229. One is mounted on the tube cover panel, 272, and the other is placed in the cockpit. These charts cannot be used to tune the receiver to an exact predetermined frequency, but are intended merely as a general guide in locating stations on the receiver dial.

j. Dial MC-372 and Dial MC-390

Similar approximate calibrations are shown on Dial MC-372 and Dial MC-390. Dial MC-372 is designed to be mounted on Tuning Unit MC-125 (remote) for use when Coil Unit C-439 is plugged into receiver. Dial MC-390 is similarly used when Coil Unit C-440 is plugged into the receiver.

tube is designed primarily as a radio-frequency amplifier. In operation, the control grid is biased negatively by an amount depending upon the amplification desired and the screen grid is maintained at a positive potential of approximately one-half the plate voltage. The control grid terminal is brought out at the top of the glass envelope of the tube. The heater, screen grid, cathode and plate terminals are brought out through five prongs in the tube base. Functionally, the tube is characterized by; (a) high amplification factor; (b) small variation in plate current with control grid bias at high values of negative bias; (c) high internal plate resistance; (d) low power output.

Tube VT-37 is a triode comprising an indirectly heated cathode, a control grid, and a plate. The cathode and heater are the same as those used in Tube VT-49. The heater, cathode, control grid and plate terminals are brought out through five prongs in the tube base. In Radio Receiver BC-AS-229, the grid and plate electrodes are connected externally to serve electrically as a single anode, and the tube is used as a two-electrode detector, without external direct current voltages

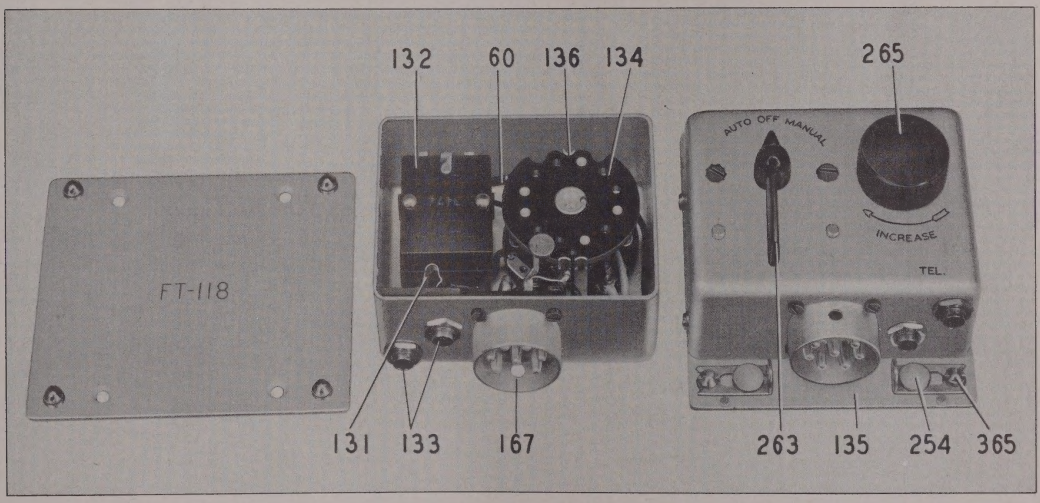


FIGURE 7—RADIO CONTROL BOX BC-AS-231 (RECEIVING)

k. Vacuum Tubes

Tube VT-49 is a pentode comprising an indirectly heated cathode, a control grid, a screen grid, a suppressor grid internally connected to the cathode, and a plate. The oxide-coated cathode is heated by a two-terminal "heater" filament. The

on any electrode except the voltage developed by the rectification of amplified radio signals. When used in this manner it presents a single internal resistance of the order of 300,000 ohms to the two terminals through which it is connected to the receiver circuit.

PAR. 5

Tube VT-38 is a pentode comprising an indirectly heated cathode, a control grid, a screen grid, a suppressor grid, and a plate. The heater and cathode are the same as those used in Tube VT-49. It is designed primarily for use as a high-gain audio-frequency amplifier. In operation, the control grid is given a permanent negative bias and the screen grid is maintained at a positive potential less than that of the plate. The suppressor grid, which is positioned between the screen grid and the plate, is permanently connected to the cathode inside the tube. The control grid is brought out at the top of the glass envelope. The heater, cathode, screen grid, and plate terminals are brought out through five prongs in the tube base. Functionally, the tube presents a compromise between the high amplification with low power output which characterizes a screen grid tetrode, and the relatively low amplification with large power output which characterizes the ordinary triode.

The following table gives the significant constants of typical Tubes VT-49 and VT-38 within their operating range, in this receiver.

	Tube VT-49	*Tube VT-38*
Heater Voltage . .	6.3 v	6.3 v
Heater Current . .	0.3 amp	0.3 amp
Control Grid Voltage	−3 v	−12 v
Screen Grid Voltage	90 v	120 v
Plate Voltage . .	180 v	165 v
Plate Current . . .	0.0045 amp	0.01 amp
Amplification Factor	750	100
Plate Resistance .	750,000 ohms	80,000 ohms

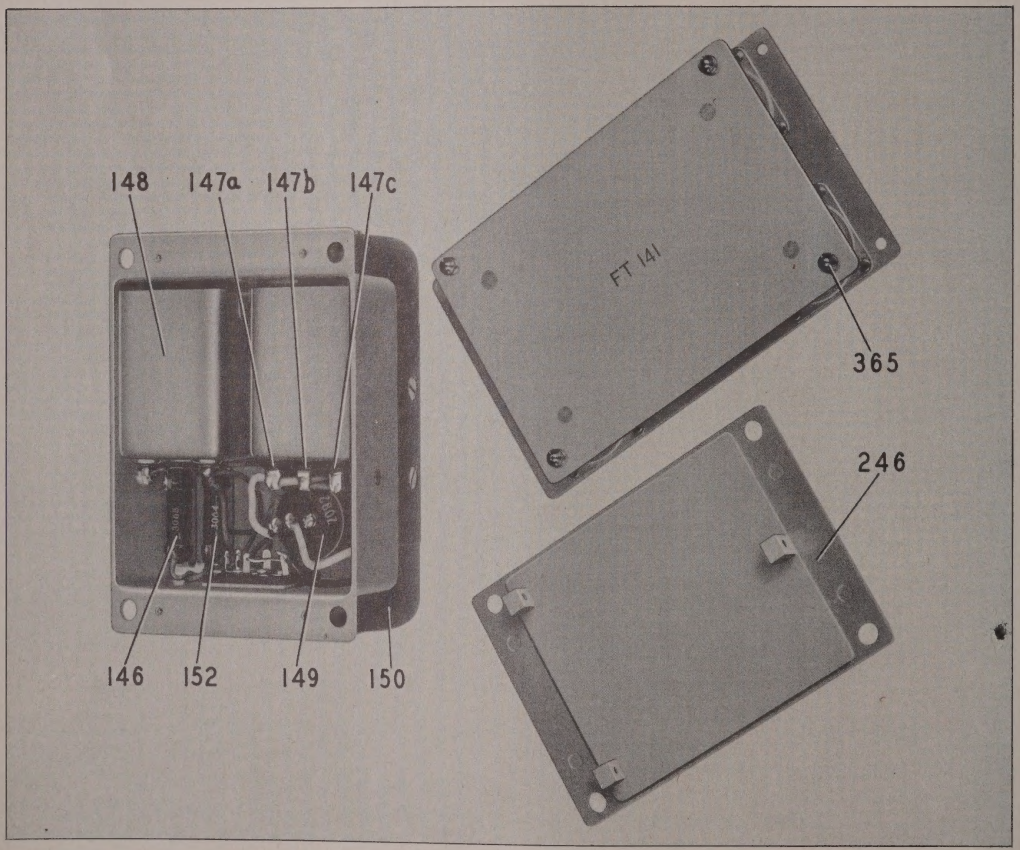


FIGURE 8—DYNAMOTOR UNIT BD-AS-83, BOTTOM VIEW

Tube VT-52 is a triode comprising a directly-heated filament, a control grid, and a plate. It is designed primarily for use as an audio-frequency power amplifier, and is characterized by large filament emission, low amplification factor and low internal plate resistance.

Tube VT-25-A is a triode comprising a directly-heated filament, a control grid, and a plate. It is designed primarily as an oscillator and radio-frequency amplifier, and is characterized by somewhat higher amplification factor and internal plate resistance than Tube VT-52. The filament is the same as the filament of Tube VT-52, but the plate and grid are spaced differently. It also differs from Tube VT-52, which has a bakelite base, in that it is equipped with a ceramic base having low dielectric constant and low dielectric losses at radio frequencies.

The following gives the significant constants of typical Tubes VT-25-A and VT-52, within their operating range in Radio Transmitter BC-AS-230.

	Tube VT-25-A	*Tube VT-52*
Filament Voltage.	7 v	7 v
Filament Current.	1.2 amp	1.2 amp
Grid Voltage . . .	–20 v	–40 v
Plate Voltage . . .	300 v	300 v
Plate Current . . .	0.025 amp	0.035 amp
Amplification Factor	8	3.6
Plate Resistance .	4,000 ohms	16,000 ohms

SECTION II

EMPLOYMENT

6. INSTALLATION

a. Bonding and Shielding of Plane Components

While applicable to all types of aircraft having 12.0 to 14.25 volts supply, Radio Set SCR-AS-183 is primarily designed for single-seat types, and the problems of installation and arrangement are chiefly centered about the rigid requirements which are associated with pilot operation. Before installation of the radio equipment the aircraft engine, generator and accessories, must be completely shielded, and bonded if satisfactory radio results are to be obtained.

Specifications and requirements for shielding and bonding set forth in Air Corps Technical Orders are adequate for airplanes in which Radio Set SCR-AS-183 is to be used. The proper criterion of a complete job of bonding and shielding is that with the airplane in flight (or with the engine running on the ground) in clear cold weather when static is negligible, no sound will be audible in the headset except radio signals, when the receiver volume control is set at a maximum. If the airplane is maintained in this condition, extremely long distance ranges of reception may be obtainable with this equipment.

b. Antenna Requirements

1. *Operation on Separate Antenna for Radio Receiver BC-AS-229*

The placement of Radio Receiver BC-AS-229 must be governed by its proximity to a suitable location for the receiving antenna lead-in. This is particularly important when the equipment is to be used in the high-frequency band. The location of the antennas and equipment will be discussed chiefly with reference to single-seated airplanes. Extension of these principles to larger types is relatively simple.

(a) Ideal installation: Connect Radio Receiver BC-AS-229 to the antenna lead-in by means of a single conductor insulated with thin rubber or a wax impregnated fabric wrap. Suspend antenna in air throughout its length. Use conductors of B&S gauge sizes 16 and 18 for radio receiving antenna connections inside the airplane. The capacity of such a conductor is relatively small. This lead should be located so that it is not likely to be struck or subjected to stresses involving the tensile strength of the wire. If it is necessary that this lead be longer, and supported along its length, space it away from the metal structure members by at least one-half inch. Use either ceramic insulators for this purpose or dry wooden blocks dipped in paraffin wax.

(b) If for physical reasons, it is impossible to position the receiver binding posts closer than one foot away from the lead-in insulator, reduce the harmful shunting effect of this lead by using as small a copper wire as is consistent with mechanical strength and by choosing a thinly insulated or bare conductor. Do not tape this lead to metal longerons or ribs if it can be avoided.

(c) Another suitable receiving antenna, provided that the lead to the fuselage is not too long, is a five-foot vertical mast antenna mounted on the fuselage of the airplane. Locate this type antenna not less than two feet away from the base of the vertical fin.

(d) A third receiving antenna suitable for high speed airplanes is a single wire slanting from the lead-in insulator in the headrest fairing up to a stub mast on top of the rudder. Extend the stub mast at least 12 inches above the top of the rudder and for effective reception, break the antenna by a strain insulator located 6 to 10 inches ahead of the stub mast.

(e) For all biplanes and high-wing monoplanes, use a flat-top antenna consisting of a top section strung between the wing tip and rudder, with down lead connected to this top section at a point well ahead of the rudder. Keep the remote ends of any wire antenna away from metal end supports. Bring down leads into the fuselage as near the bottom of the fuselage as possible.

(f) When using separate antennas Radio Receiver BC-AS-229 may be mounted back of the seat, with its axis of length across the fuselage, and its antenna binding post wired to a separate lead-in- insulator.

2. *Operation on Separate Antenna for Radio Transmitter BC-AS-230*

There are three important requirements or characteristics of the transmitting antenna. The first, has a sufficiently high capacity at the operating frequency been provided so that the greater part of the radio energy goes out into the space-part of the antenna and is not dissipated internally in

the coupling circuit or fuselage. Second, the antenna resistance should be due largely to radiation and not to conductor or dielectric losses. Third, the directions of minimum radiation should be at angles from the airplane which will coincide with the direction of the receiving airplane only in the least probable attitudes of flight.

(a) A transmitting antenna which fulfills the requirements outlined above, in the 6,200-7,700 kc frequency band, consists of a T structure having a flat top section which is between 16 to 18 feet long, with a down lead about 9 feet long to the lead-in insulator. If an L antenna is used, its total length from the lead-in insulator to the end of the top section should be 20 to 25 feet. For the 2,500-5,000 kc band a V shaped flat top about 25 feet long on each leg, with a down lead about 10 feet long may be used with fair success in this band.

NOTE: The lead inside the fuselage to the transmitter antenna binding post must be short, and must be either bare or insulated with high-quality insulation regardless of the location of the transmitter.

(b) General rules as a guide in all cases for installing a transmitting antenna are as follows: Try to keep the capacity elements of the antenna outside the fuselage and minimize the capacity of all conductors inside the fuselage. Where such capacity exists inside the fuselage, the dielectric (insulators) should consist of air, glass or porcelain. If ceramic insulators are unobtainable, use hard rubber (do not use bakelite). The ground binding post of the transmitter is bonded to the fuselage by a permanent short lead, which must have sufficient slack so as not to impair the shock-proofing action of the mounting.

3. *Operation on Single Antenna*

If Radio Receiver BC-AS-229 and Radio Transmitter BC-AS-230 are to be operated from the same antenna through the use of Antenna Switching Relay BC-AS-198, mount the receiver and transmitter close to each other so that the lead inside the fuselage to the transmitter binding post is short. For best results place these units not more than one foot apart. Place and mount Antenna Switching Relay BC-AS-198 so that its binding posts are not over one foot away from the antenna binding posts of both receiver and transmitter and also as close as possible to the lead-in insulator of the common antenna. Bond the cord from the relay to junction box to the metal members of the airplane at frequent intervals along its length. Connect three short leads; the antenna to the ANT. binding post of the relay, the receiver A binding post to the REC. binding post of the relay, and the transmitter A binding post to the TR. binding post of the relay. Use #16 or #18 bare wire insulated by beads of glass or porcelain for these three leads. See Paragraph 6b 2. for dimensions of the single transmitting-receiving antenna.

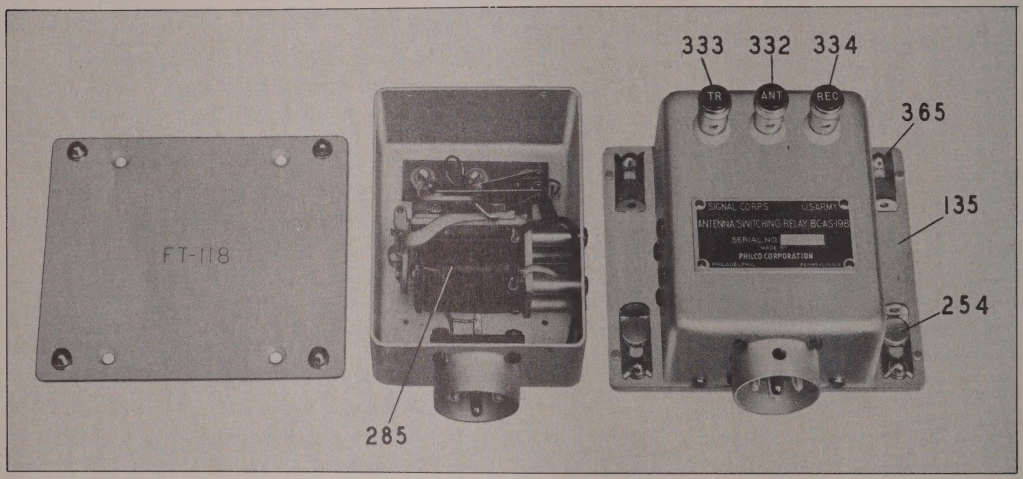


FIGURE 9—ANTENNA SWITCHING RELAY BC-AS-198

c. Installation of Components

1. *Radio Receiver BC-AS-229 and Radio Transmitter BC-AS-230*

There are several important factors to consider when choosing the position for permanently mounting the receiver and transmitter in the airplane. Be sure the equipment is within convenient reach of the pilot for changing coil sets and replacing tubes. Nearness to the receiving antenna lead-in is equally essential. Avoid sharp bends in the tuning shaft and cords. Weight distribution to the receiver and the effect of shock-proofing will be lost.

2. *Radio Control Box BC-AS-231 and Radio Control Box BC-AT-232*

Radio Control Box BC-AS-231 (receiving) must be accessible to the operator whether the equipment is pilot-operated and remotely controlled or locally controlled. During any series of communications the switch on Radio Control Box BC-AS-231 must be used to turn the equipment off and on and the volume control knob will also be used

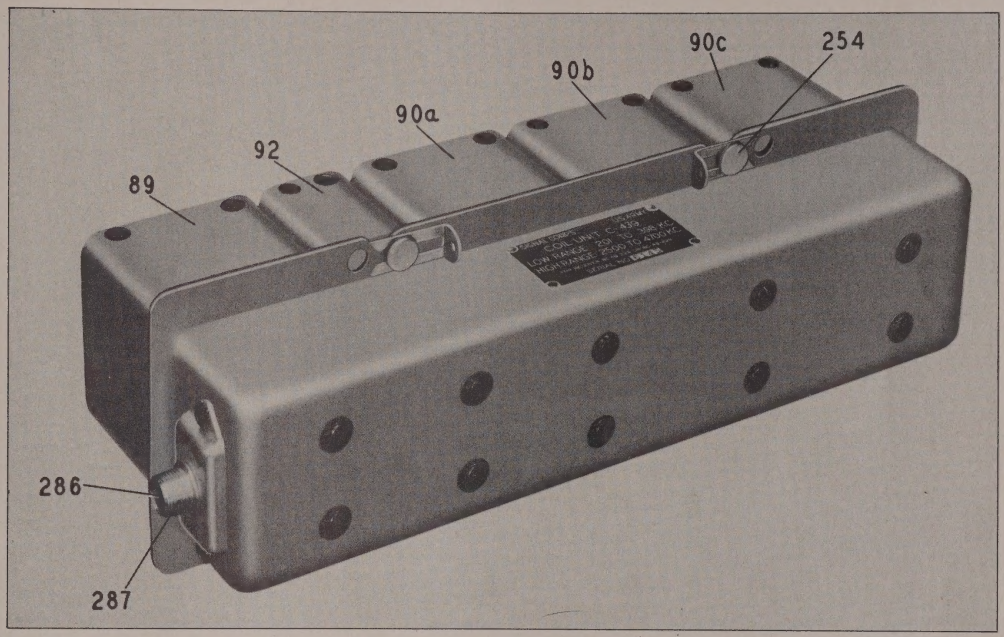


FIGURE 10—COIL UNIT C-439 (DUAL, RECEIVING)

must also be carefully considered. Place the receiver and transmitter mountings in the position selected with these points carefully considered. Attach the receiver and transmitter to them by means of the snapslides on the mounting brackets. These units may then be easily unsnapped and removed for inspection and replacement. Be sure snapslides are all firmly fastened on their respective studs and securely closed. Allow sufficient slack in every cord, shaft and conductor attached to the receiver so that the receiver is free to move in every direction with respect to its mounting. If even a single wire is attached to the receiver case, the airplane vibration will be transmitted direct constantly. Radio Box BC-AT-232 (transmitting) is used for key transmission and selection of the type of emission from Radio Transmitter BC-AS-230 and not for the changeover operation between send and receive. If communications are to be confined to voice only, Radio Control Box BC-AT-232 does not need to be as handy if it is necessary to favor one at the expense of the other. During any series of communications turn switch for on or off position. These units have no shockproofing and are attached to their Mounting FT-118 by means of snapslides. The mountings may be screwed directly to the cowling or to a panel inside the cockpit.

3. *Dynamotor Unit BD-AS-83*

Place Dynamotor Unit BD-AS-83 in an upright position with Mounting FT-141 so placed as to be horizontal in normal flight. Do not mount it closer than two feet from the receiving antenna lead-in. The location must be such that its cord is no longer than necessary, since this cord carries a relatively heavy supply current. The voltage drop in this cord when carrying 8 amperes should in no case exceed 0.5 volt. Mounting FT-141 is permanently fixed in the airplane and Dynamotor Unit BD-AS-83 may be removed for inspection or replacement by releasing the snapslides.

4. *Junction Box*

In new airplanes a junction box is furnished and installed in the airplane by the airplane manufacturer. It should provide the circuits shown in Figure 19 for proper operation of Radio Set SCR-AS-183. If the airplane is not equipped with a junction box already installed in the airplane a separate junction box TM-AH-172 (see Figure 2) is available.

5. *Tuning Unit MC-125, Control Unit MC-135 and Tuning Shaft MC-124 and Control Shaft MC-134*

Certain Signal Corps tuning and control units are required for the operation of Radio Set SCR-AS-

SIGNAL CORPS U.S. ARMY

CHART MC-401 FOR RADIO RECEIVER BC-AS-229

FREQUENCY IN KILOCYCLES

REC DIAL	COIL UNIT C-439 LOW	COIL UNIT C-439 HIGH	COIL UNIT C-440 LOW	COIL UNIT C-440 HIGH	COIL SET C-441	COIL SET C-442	COIL SET C-443	COIL SET C-444	COIL SET C-445	COIL SET C-436	COIL SET C-437	COIL SET C-438
0	200	2470	200	4100	146	193	390	780	1535	2390	4040	6480
10	215	2660	215	4400	157	209	420	840	1650	2580	4340	6950
20	236	2900	236	4780	173	229	461	922	1810	2825	4740	7600
30	259	3170	259	5230	190	252	508	1015	1990	3100	5190	8350
40	283	3470	283	5670	209	277	558	1117	2185	3410	5660	9100
50	307	3750	307	6110	228	303	608	1220	2380	3700	6120	9850
60	329	4010	329	6530	246	326	657	1315	2560	3990	6550	10550
70	350	4250	350	6880	262	348	702	1405	2730	4240	6930	11200
80	368	4460	368	7200	277	368	743	1485	2880	4470	7270	11730
90	385	4650	385	7480	291	387	780	1565	3025	4690	7600	12250
100	400	4830	400	7730	304	405	815	1635	3160	4880	7880	12700

MADE BY PHILCO CORPORATION PHILADELPHIA, PENNSYLVANIA

FIGURE 11—CHART MC-401 AND DIAL MC-372

183 and their proper location is indicated diagrammatically in Figure 20. These tuning and control shafts can be obtained from depots in any required length and should never be cut unless proper equipment is available for reattaching the splines. Each shaft consists of a casing terminating in a ferrule and a coupling nut; this houses the shafting, terminating in an assembly of a spline on a spline-ferrule. The shafting is made up of tightly wrapped steel wires which will not hold their shape unless they are soldered or swaged together at the ends. All tuning and control shafts should be taped and bonded.

Radio Receiver BC-AS-229 will normally be remotely tuned by means of Tuning Unit MC-125 and Tuning Shaft MC-124. The tuning unit is mounted near Radio Control Box BC-AS-231 since it will be used during the operation of the receiver. The tuning shaft may be bent more than once throughout its length but no bend should have less than a 6 inch radius. The shaft is firmly secured to a rigid support at frequent intervals along its length, except at points close to its attachment to the receiver. If both these precautions are not observed it will be difficult to tune the receiver accurately. When properly installed, even with lengths of 20 feet or more of shaft, both dials should rotate smoothly (without appreciable backlash) as the crank of the tuning unit is turned. When the shaft is attached to outlet 261 on the receiver and to the tuning unit the reading of the tuning unit dial must be made to coincide with the reading of the receiver dial by rotating one of them before final coupling is made.

The coil unit switch of either Coil Unit C-439 or Coil Unit C-440 may be operated remotely by means of Control Unit MC-135 through Control Shaft MC-134 if desired. This control shaft differs from the tuning shaft in that it has direct coupling between the gang switch and the control unit lever, and is consequently stiffer than the tuning shaft. Any bends in a control shaft must be of the greatest possible radius. In the case of the coil unit the control shaft carries a considerable load (the gang switch in the coil unit) and extra precautions must be observed on installation. Before mounting Control Unit MC-135 the spline of this unit should be inserted into the control shaft and the switch should be turned clockwise to be certain that the coil unit gang switch is set for the LOW range. Disengage Control Unit MC-135 and re-engage the spline in one of the four ways which will locate the lever, when set for the LOW range, in the most desirable position. Rotate the dial until LOW is indicated by the pointer and then tighten the coupling nut. Do not attempt to rotate the dial of Control Unit MC-135 after this operation. The dial should then be secured in position by screws attached to the unit. When properly assembled the change-over between the HIGH and LOW bands of the coil unit, by means of the lever on Control Unit MC-135 should be positive and reversible.

6. Cords

Cords which inter-connect the various units, if not in rigid metal conduit, are lashed or clamped to structural members of the airplane along their length. Cords which are covered with metal braid may produce an electrical noise in the receiver unless they are carefully bonded to metal airplane members wherever they are likely to touch or rub thereon. In the best installations such cords are bonded at intervals of approximately 18 inches and the intervening length, between bonds, are wrapped with friction tape or similar insulation, to eliminate all possibility of receiver "noise" arising from this source.

The cord to the battery terminates at its battery end in a pair of open terminals. These must be connected to the 12-14.25 volt line as near to the battery as practicable. If a conductor of any length whatever carrying current from the charging generator to the battery is included in the circuit between the positive conductor of this cord and the battery terminal, it may produce electrical noise in the receiver which will come from the voltage regulator. In case it becomes necessary to alter or assemble a shielded cord, the attachment of the plug should be made as follows. The plugs for these cords consists of a shell, insulator body, spring, bushing, washer, nut and screw. Cut the cordage off squarely across the end. Then cut the metal shielding braid back a distance of $1\frac{3}{16}$ inches from the end; with a sharp knife or scissors cut the rubber jacket back a distance of $\frac{3}{4}$ inch from the end, taking care not to damage the rubber insulation of the individual conductors. Then clean the insulation on each individually stranded conductor back a distance of $\frac{5}{32}$ inch from the end. Disassemble the plug by removing the screw and nut.

Pass the nut, washer, and shell over the cleaned end of the cable in the order named. Having threaded the cable through these parts, tin the end of the braid with hot solder, fit the bushing over the end of the cable and braid, so that the braid is covered to a distance of $\frac{3}{8}$ inch, and sweat the

braid into the bushing so that a secure soldered contact is made between the bushing and the braid. Tin each individual contact; insert and solder the cleaned ends of the conductors into these inserts. Both the inserts and the conductors must be thoroughly tinned before this operation. Do not allow surplus lumps of solder to remain on these inserts or on any part of the insulation. When all conductors are securely soldered, bunch the insulated portions together so that they will not rub on the shell when the plug is reassembled. Draw the shell up to the shoulder on the bushing and fasten it securely by tightening the nut. As this operation is performed, the hairpin spring must be held in close contact with the inner surface of the shell, with two studs protruding through the holes in the top of the shell. As the shell is drawn up to the shoulder of the bushing, the insulator body, now attached to the cable, should be drawn into this shell so that the spring passes into and is held in the square groove in the top of the insulator body. Line up the screw hole in this shell with the threaded hole in the bottom of the insulation and complete the assembly by tightening the screw in this hole. Do not use acid flux or paste in soldering the conductors; use only rosin flux.

When open wire cables are required they should be assembled in accordance with the procedure outlined in the preceding paragraph. The conductors in each cable should be lashed together and the cables should be lashed to structural members of the airplane.

7. *Preparation for Use*

(a) Test Before Installation in Aircraft

Two way operation with another Radio Set SCR-AS-183 will check the equipment to be installed.

(b) Adjustments After Installation

(1) *Adjustment of Radio Receiver BC-AS-229*

The final installation operation of the receiver is the alignment of the antenna circuit of the receiver by means of the input capacitor 80, adjusted by knob 244. If the antenna used is so large that its characteristics vary widely with frequency over the operating range, this adjustment must be made for each coil set. If the antenna is small, or consists of a rigid mast, one adjustment may give satisfactory results for all coil sets. Operate the receiver with switch 134 at MANUAL. Tune in a signal at the high-frequency end of one of the bands, preferably in the high-frequency band of Coil Unit C-440. Progressively retard the volume control during the adjustment to keep the signal at the lowest audible level. Turn knob 244 until the signal is a maximum. Readjust the receiver tuning for maximum and knob 244 for resonance.

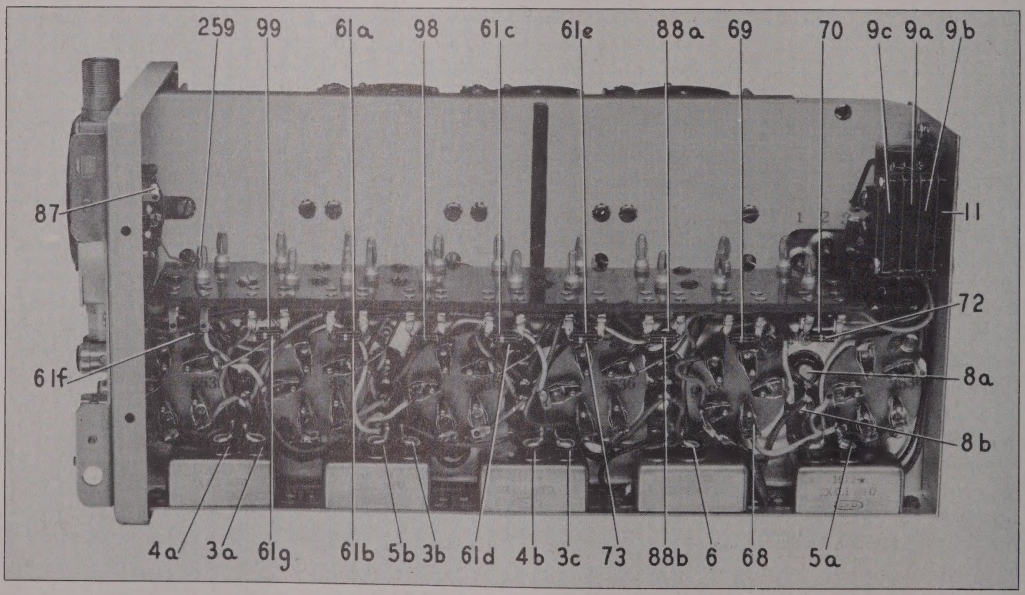


FIGURE 12—RADIO RECEIVER BC-AS-229, BOTTOM VIEW

If the receiver is to be operated for a considerable period in the low-frequency bands only, this antenna alignment may be performed near the maximum (frequency) dial setting on the low-frequency coil set. For use throughout the entire range the antenna alignment must be performed on one of the high-frequency bands.

Do not operate the receiver with any coil set if it is impossible (owing to the size or arrangement of the antenna and lead-in) to adjust knob 244 for

ceptacle plate 163), and connect the wire to filter choke 94; (2) remove the black wire connected to terminal 6 on modulation transformer 124 in the transmitter and connect the wire to terminal 7 on the same transformer.

(2) *Adjustment of Radio Transmitter BC-AS-230*

Tune and adjust Radio Transmitter BC-AS-230 on the ground for operation at the desired transmitting frequency. Tune over dry soil otherwise

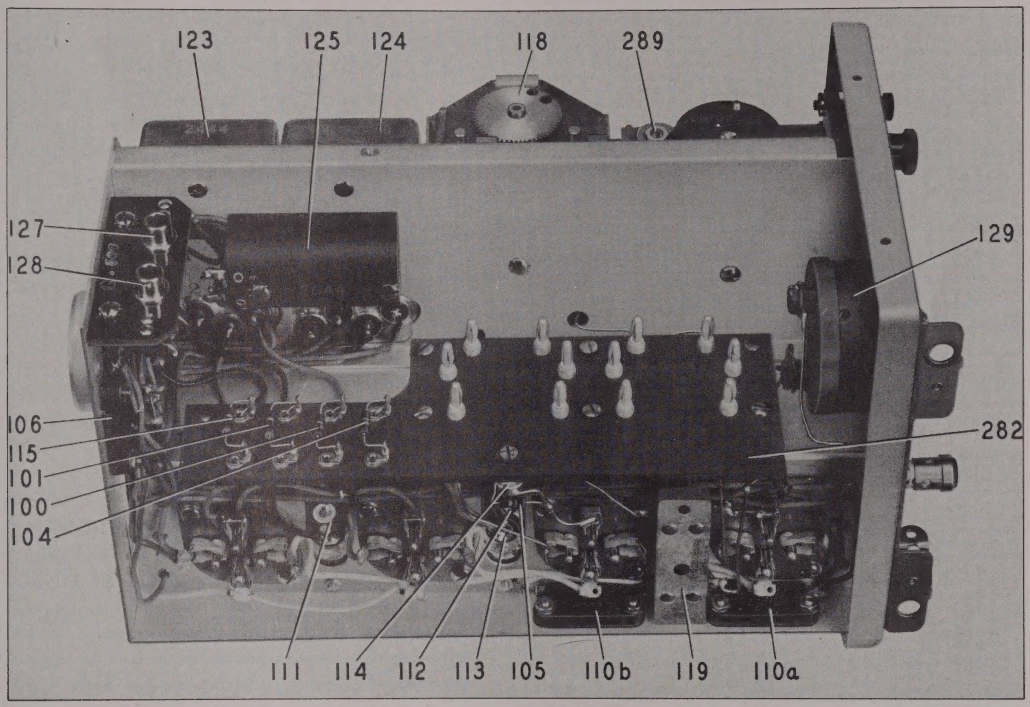


FIGURE 13—RADIO TRANSMITTER BC-AS-230, BOTTOM VIEW

resonance as indicated by maximum signal. The overall sensitivity will be low and the results will be unsatisfactory unless capacitor 80, controlled by knob 244 is accurately adjusted.

The receiver output circuit and transmitter sidetone circuit are arranged to permit the use of two 8000 ohm or two 600 ohm headsets in parallel. The receiver and transmitter are supplied with these circuits wired for low impedance (600 ohm) headsets. When the high impedance headsets are to be used the receiver and transmitter must be modified as follows. (1) Remove the black wire from terminal 4 on output transformer 71 in the receiver (which comes from 55 on re-

the tuning of the antenna circuit may change when the plane leaves the ground.

The transmitter cannot be properly tuned inside a hangar. Three controls must be adjusted for any given frequency: (1) the frequency control 241; (2) the antenna coupling tap, adjusted by sliding contact 130; (3) the antenna tuning capacitor, adjusted by knob 243. The frequency control 241 (which operates the variable capacitor of the radio master oscillator) should be set at the desired transmission frequency by comparison with the chart. Lock with lockscrew 250 and let it alone. Trial-adjust the antenna coupling and tuning (coil tap 130 and capacitor knob 243) to

give the most favorable combination of antenna carrier current (indicated by ammeter 129) and modulation. Proper adjustment of the antenna circuit is particularly important in the case of Radio Transmitter BC-AS-230 as operation with the wrong setting of the coil tap may result in dynamotor overload and poor modulation even though the antenna circuit is tuned to resonance. Study carefully and apply the following explanation.

Set the switch on Radio Control Box BC-AT-232 to VOICE and the frequency control at the desired frequency. Connect the antenna and ground to the proper binding posts and find a position for the coil contact 130 at which maximum (resonance) antenna current may be obtained by rotating capacitor knob 243; note the value of the antenna current at this setting. Remove the transmitter coil set, change the position of contact by one or two turns, replace the coil set and retune to resonance with knob 243, noting the new resonance value of antenna current. Repeat this operation of adjusting contact 130 and retuning to resonance until the position has been found for the coil contact at which the antenna current reaches its highest value when the circuit is tuned to resonance by capacitor knob 243. It will be noted at most operating frequencies that the antenna current at resonance does not change appreciably between one turn of the antenna coil and the next adjacent turns on each side, throughout a certain region on the coil in the vicinity of maximum power output, but at certain locations of contact 130, better modulation will be obtained than at other locations, and good modulation is just as important in voice transmission as is high antenna current. In the absence of any direct means of checking modulation, the direct plate current of the amplifier tube, measured on a d-c milliammeter plugged into jack 128 on the transmitter, may be used as a practical indicator of the extent to which the radio amplifier may be modulated without distortion. In general, the greater the amplifier plate current, at resonance, when the transmitter is tuned and operating on voice, the smaller will be the power available for modulation, and the smaller the modulation capability of the transmitter.

The radio carrier current (indicated by antenna ammeter 129) generally decreases with decreasing plate current drawn by the amplifier; thus a compromise must be made in choosing the final location for coil contact 130. In choosing this compromise location, the following practical data will be of assistance. This applies to a transmitter operating at 14 volts supply voltage with average tubes. For a 12 volts supply the corresponding plate currents are 20% lower than those given below.

With settings of the coil contact at which the amplifier plate current is less than 25 milliamperes the radio output will be modulated up to 100% with negligible distortion.

With settings of the coil contact at which the amplifier plate current is between 25 and 30 milliamperes the radio output will be modulated to about 90% with negligible distortion.

With settings of the coil contact at which the amplifier plate current is between 30 and 35 milliamperes the radio output will be modulated to about 80% with negligible distortion.

With settings of the coil contact at which the amplifier plate current is greater than 35 milliamperes the output cannot be modulated above 70-75% without serious distortion. Such settings should be avoided.

All the above values apply to operation at antenna resonance, obtained by tuning with knob 243. If the antenna circuit is mistuned, all plate currents will be abnormally high and satisfactory modulation cannot be obtained at any antenna coupling. Consideration of the preceding four paragraphs indicates a working rule for final choice of position for the antenna coil contact, as follows:

At any given frequency the coil contact 130 is set for the highest antenna current (on meter 129) which can be obtained, at resonance, without drawing an amplifier plate current, at resonance, which exceeds 34 milliamperes at 14 volts supply or 28 milliamperes at 12 volts supply. This will permit modulation of at least 80%, with normal modulator tubes, at a carrier current output which is practically the maximum attainable. It will be noted that moving the coil contact down toward the coil base from the point just specified (i. e., decreasing the coupling to the antenna) usually decreases the amplifier plate current at resonance and improves the modulation, but at the expense of decreased antenna current. This observation suggests the following rough rule for tuning the transmitter in the absence of a d-c milliammeter for measuring the amplifier plate current:

If a d-c milliammeter is not available for indicating plate currents when the transmitter is being

tuned, set the coil contact 130 on the turn which gives the maximum antenna current at resonance, then move it down toward the base of the coil (restoring resonance at each move by adjusting knob 243) until the antenna current on meter 129 is reduced by a small amount, say 5% below its maximum resonance value. In other words, operate the transmitter with the antenna coupled through contact 130 by an amount slightly less than the coupling which gives an absolute maximum of antenna current.

In Radio Transmitter BC-AS-230 a choice of two side-tone levels is available, owing to the provision of a tap on the side-tone winding of transformer 124. As supplied, the transmitter is connected for an average side-tone level of approximately 10 volts across two 8000 ohm phones. This voltage may be reduced by 50%, if desired, by transferring the soldered connection from terminal 7 of transformer 124 to terminal 6.

WARNING: Radio Transmitter BC-AS-230 must never be operated with the antenna mistuned from resonance except during the tuning process. Unless the antenna circuit is operated at resonance as indicated by the antenna ammeter the tubes and dynamotor unit are liable to damage and proper modulation cannot be obtained.

(3) *Transmitter Frequency Calibration*

The frequency calibration chart mounted on the back of each coil set applies only to the combination of that coil set and the transmitter bearing the same serial number. The calibration is affected to a certain extent by the electrode capacities of Tube VT-25-A used in the radio oscillator socket (second from the front of the transmitter as shown in Figure 15). The particular oscillator tubes with which the calibration charts were made are supplied with the transmitters. When a transmitter is first placed in service be sure that Tube VT-25-A placed in the radio oscillator socket is the one stamped with the serial number of that transmitter. This tube only, should be used as the radio oscillator throughout the life of the tube. With any other tube in the oscillator socket the calibration errors may be as great as 1% at the high-frequency ends of some frequency bands. See Paragraph 22 for replacement of Tube VT-25-A. To determine an exact dial setting, proceed as follows:

Set the frequency control to the desired frequency as indicated by the coil set calibration chart.

Tune the antenna circuit to resonance, using the antenna coil tap which gives maximum antenna current and satisfactory voice modulation.

Allow the transmitter to warm up for five minutes.

Readjust the frequency control for zero-beat with a crystal-controlled frequency standard whose frequencies are known with a maximum error of 0.05%. Frequency Meter Sets SCR-211-A, SCR-211-B and SCR-211-C are more accurate than the above value.

After readjusting the antenna circuit for resonance, make a final adjustment of the frequency control to obtain a zero-beat signal.

This data and suitable means for identifying the particular coil set and transmitter should be recorded.

If the oscillator tube is replaced at any time, recheck the data for a given frequency. If the output frequency is found to differ from the frequency standard, correct by adjusting trimmer capacitor 120, accessible under cover 288 on the transmitter case. When zero-beat has been obtained at one of the operating frequencies, the calibration data will be correct for each of the operating frequencies.

7. OPERATION

a. General

Radio Control Box BC-AS-231 turns off all power to the equipment. When switch 134 is in the OFF position Dynamotor Unit BD-AS-83 is disconnected and power is thrown off the filaments of both Radio Receiver BC-AS-229 and Radio Transmitter BC-AS-230 for all positions of all other controls. With the switch on Radio Control Box BC-AS-231 at either AUTO or MANUAL the dynamotor runs and the type of reception is determined. The switch on Radio Control Box BC-AT-232 determines the type of transmission. The application of the dynamotor output voltage (whether to the receiver or to the transmitter) may be determined by the operator, by using either a remote control switch plugged into the junction box, the microphone switch, or the key. The following is a summary of the power connections accompanying each position of the main switches:

Radio Control Box BC-AS-231:

OFF: dynamotor off. Receiver and transmitter filaments off.

MANUAL: dynamotor on. Receiver and transmitter filaments on. Plate voltage on either transmitter or receiver.

AUTO: dynamotor on. Receiver and transmitter filaments on. Plate voltage on either transmitter or receiver. Radio Control Box BC-AT-232: (with switch on Radio Control Box BC-AS-231 at MANUAL or AUTO and a control switch closed to transmit):

TONE: transmitter filaments on. Plate voltage off receiver. Plate voltage on all transmitter tubes. Modulator generates tone oscillations. CW: transmitter filaments on. Plate voltage off receiver; on all transmitter tubes. Modulator generates tone oscillations.

VOICE: transmitter filaments on. Plate voltage off receiver; on all transmitter tubes. Tone oscillations suppressed.

b. Operating Test for Radio Receiver BC-AS-229

After installation and before flying with Radio Set SCR-AS-183 a receiver operating test must be made for which detailed instructions follow:

1. Plug a coil set into the receiver corresponding to a frequency band in which signals will be available for test purposes. See that the full frequency range on the tuning dials can be swept through for the chosen position of the tuning unit pointer without encountering the stops on this unit. The tuning unit should turn easily and smoothly and should not be forced at any time.

2. Plug telephone receivers into a jack on Radio Control Box BC-AS-231. Turn the switch to MANUAL. The dynamotor should start and as soon as the receiving tubes are warm, a slight hum will be heard in the telephones indicating that the receiver is operating. Make the first test without running the airplane engine. When the receiver is in operating condition at full voltage, atmospheric and electrical disturbances are usually heard at the maximum position of the volume control. Under most conditions the receiver cannot be expected to operate satisfactorily on signals so weak that maximum sensitivity is required to make them audible, because such signals are usually below the atmospheric noise levels.

3. Tune in signals by rotating the tuning unit crank. As the receiver is tuned, adjust the volume control knob for suitable signal intensity.

4. Switch to the AUTO position of the control switch after a desired signal is tuned in. The signal intensity in the telephones will not necessarily be the same for the same setting of the volume control in the AUTO and MANUAL positions. In the AUTO position, reset the knob for a suitable level in the telephones. If the mean radio field strength is high enough to require substantial retardation of the control knob for a comfortable signal output in the MANUAL position, the signal output in the AUTO position will be maintained constant by the automatic gain control of the receiver. Do not attempt to tune in signals with the switch on AUTO. Since the amplifier gain varies with the strength of the amplified radio voltage in this position, the resonance effect in the amplifier is apparently broadened so that the proper tuning point cannot be found in the AUTO position except for very weak signals. The AUTO position is not designed for constant use throughout a series of communications on different frequencies, but only as an aid to reception after a signal has been tuned in on the MANUAL position.

5. Before using the receiver in flight, check the installation with the airplane engine running. Set the volume control at maximum in any position of the tuning dial and hear if the electrical noise in the telephone is increased on starting the airplane engine. If so, it indicates imperfect shielding of the ignition or generator system, or difficulty with the voltage regulator of the charging generator. If circumstances render necessary the operation of the receiver under these conditions only those radio signals can be satisfactorily received which are of greater electrical intensity than the local disturbance.

6. Never leave the switch on Radio Control Box BC-AS-231 in the MANUAL or AUTO positions when Radio Receiver BC-AS-229 is not in use.

c. Operating Test for Radio Transmitter BC-AS-230

After installation and before flying with the radio equipment an operating test for Radio Transmitter BC-AS-230 must be made, for which detailed instructions follow:

With telephone receivers in the jack in Radio Control Box BC-AS-231, plug a microphone into jack 138 in Radio Control Box BC-AT-232, and set the controls at MANUAL and VOICE. The dynamotor should run and Radio Receiver BC-AS-229 should operate.

Press the switch on the microphone. A click should be heard in the phones and the antenna-current ammeter should deflect to a reading of at least 0.5 ampere. Talk into the microphone. Voice side-tone should be heard in the phones and the antenna-current ammeter should fluctuate with the modulation from the voice. If the antenna current does not vary with voice modulation either the transmitter is not being modulated or it is improperly tuned.

Throw Radio Control Box BC-AT-232 switch to TONE, and press either the microphone switch or the key. A steady tone should be heard in the phones and the antenna current should increase appreciably above the value observed on VOICE. If the antenna current does not increase on TONE the transmitter is improperly tuned.

Throw Radio Control Box BC-AT-232 switch to CW and press either the microphone switch or the key. A steady tone should be heard in the phones but the antenna current should be the same as on VOICE position with no modulation.

8. MICROPHONE TECHNIQUE

Voice communication from an airplane is always characterized by restricted ranges of operation as compared with communication by CW and tone telegraph. Signal fading, airplane noises, electrical interference, atmospherics, and the like, all conspire to rob a voice-modulated radio signal of its intelligibility. For that reason it is of the utmost importance that voice communication, when used, should originate at the microphone under the most favorable possible conditions. All audible flight noises are picked up by the microphone and transmitted through the radio set. It is impossible to eliminate them to a marked degree without also eliminating the intelligence-bearing frequencies of the human voice. The only expedient under the control of the operator, for discriminating against flight noises, in favor of his voice, is to keep his lips close to the microphone. Flight noises cannot be drowned out by shouting into the microphone; this is a bad practice from all standpoints since it produces fatigue and distortion in the human larynx and also overloads the equipment. The following simple rules may be depended upon, if followed consistently, to produce the best results in voice transmission from any radio equipment:

Hold the microphone close to the face, with lips just touching the surface. Keep the head in a vertical position while transmitting so that the plane of the microphone face is substantially vertical.

Do not shout. Forget the noise surrounding you and imagine that you are talking directly into the ear of the listener.

Finish each word completely before starting the next.

Emphasize with a distinct hiss all sibilants such as S, C and Z.

Emphasize all terminal consonants such as T and G.

Speak slowly.

9. CHOICE OF FREQUENCY

Radio communication ranges are limited by signal "fading," (i.e., rapid variations) atmospherics, and steady decay of received signal with distance.

The best frequency for transmission between two given points varies with the altitude, the distance, and the time of day, but there are a few general rules which, if kept in mind, will greatly assist in minimizing the importance of this general variability. For short distances, communication is improved with increasing altitude between two airplane stations or between airplane and ground, at all frequencies. For plane-to-plane communication at short distances there is little choice between frequencies in the low bands (2,500-5,000 kc) and frequencies in the high bands (5,000-7,700 kc). For plane-to-ground communication at any short distance, frequencies in the low bands are better than frequencies in the high bands. As to the distinction between day and night, the lower frequencies are better on the average at night, and the higher frequencies are better by day. For short-distance work with a ground station, frequencies in the lower band are used, if possible, without regard to the time of day. Frequencies in the upper part of the low band, say 4,000 kc, are best for general utility purposes, plane-to-plane, or plane-to-surface, over a variable distance range.

10. CHOICE OF TYPE OF TRANSMISSION

The CW position of Radio Control Box BC-AT-232 selector switch will give the same antenna current as the VOICE position. The TONE position will give the same carrier power output as the VOICE position but it will be modulated

100% at 1000 cycles. For long-range communication, or communication through interference, CW is most effective, TONE next, and VOICE least effective. It should be borne in mind, however, that although CW telegraphy will give the greatest distance range, and the greatest range through interference, it requires an oscillating receiver at the receiving station and because of its sharper tuning it is sometimes more difficult to establish initial communication by CW than by TONE telegraphy.

11. OPERATING ROUTINE

The operating routine of the equipment, and the choice between different types of transmission will be dictated primarily by tactical requirements and considerations external to the radio equipment. There are a few general rules which, if followed to the greatest possible extent, will increase the number of successful radio flights.

Do not take off with airplanes with which communication is desired, without first establishing communication on the ground. This is particularly important if communication is to be carried on with airplanes transmitting at different frequencies.

Whenever possible, with an assembly of airplanes, which are to work on the same assigned frequency, tune in all the transmitters on the ground by adjusting them until their carrier frequencies all beat together in a common receiver used for monitoring purposes. The calibration of the transmitters cannot be depended on to within greater accuracy than 0.05% and this represents enough frequency separation to require retuning of the receiver between the various transmitter frequencies.

Do not expect uninterrupted communication between airplanes which are maneuvering unless they are close together. For consistent communication at distances greater than five miles the communicating airplanes should be in substantially level flight. Vertical banks are usually the positions of minimum received signal between two communicating airplanes unless they both bank in the same direction. Furthermore, a dead spot of communication may be observed when the receiving airplane is off the pole of the transmitting down-lead, either above or below.

Operations may be accelerated if orders are acknowledged by single pre-coded signals on the telegraph key.

Do not expect to obtain distance ranges on VOICE in excess of twenty-five miles consistently. The distance range on key will be normally greater than the distance range using external voice modulation.

The radio field strengths received on the ground will always be less than those received in the air at a given time of day, unless the transmitting airplane is so high that an optical path lies between it and the ground station.

Transmission on these frequencies will vary from month to month and from day to day, owing to the varying characteristics of the medium of propagation. Signal strengths at distances above fifteen miles will usually be greater in winter than in summer, and may vary widely from hour to hour on a summer day. This variation is unavoidable and has nothing to do with the radio equipment.

Signal "fading" will be encountered more and more as the distance of transmission is increased. Sometimes this will be so rapid as to produce severe distortion of modulated signals. It occurs more at long distances, but may be observed at distances as short as ten miles on some occasions. If the quality of the signals suddenly becomes bad at distances of ten miles or more it does not necessarily indicate a fault in the apparatus. A test should be made with the transmitting and receiving stations in sight of each other before looking for trouble in the equipment.

SECTION III

FUNCTIONING OF PARTS

12. RADIO RECEIVER BC-AS-229 AND RECEIVER COIL SETS

a. General

Electrically, Radio Receiver BC-AS-229 comprises four stages of radio-frequency amplification which amplify at the incoming frequency, a detector and one stage of audio-frequency amplification. The four radio-frequency amplifier stages use Tubes VT-49. The detector is Tube VT-37, and the audio amplifier stage uses a Tube VT-38. Each of the coil sets includes the same essential parts of the radio-frequency amplifier circuit, and except where otherwise noted, the following discussion applies to the receiver when using any one of the coil sets.

b. Detailed

The four radio-frequency stages are coupled by five coupling circuits, four of which consist of radio-frequency transformer coils 89, 90, tuned by equal sections of the variable gang tuning capacitor 58. The fifth consists of a fixed bandpass coupling circuit which is made up of a coil 93 and a resistor 66, coupled together by a fixed capacitor 13. These three elements are included in the bandpass stage of all coil sets. The bandpass coil assembly 92 is used in Coil Unit C-440 (low), also includes a fixed capacitor 82 which serves, in cooperation with capacitor 13, as a radio voltage divider. The function of the fixed band-pass coupling between the first and second tubes of the radio-frequency amplifier is to equalize the amplification over any frequency band which is covered by rotation of the gang tuning capacitor through 180 degrees. All tubes coupled by the tuned transformers 89, 90, amplify considerably more at small values of tuning capacitance. The band pass coupling unit is designed for each coil set, so that the amplification

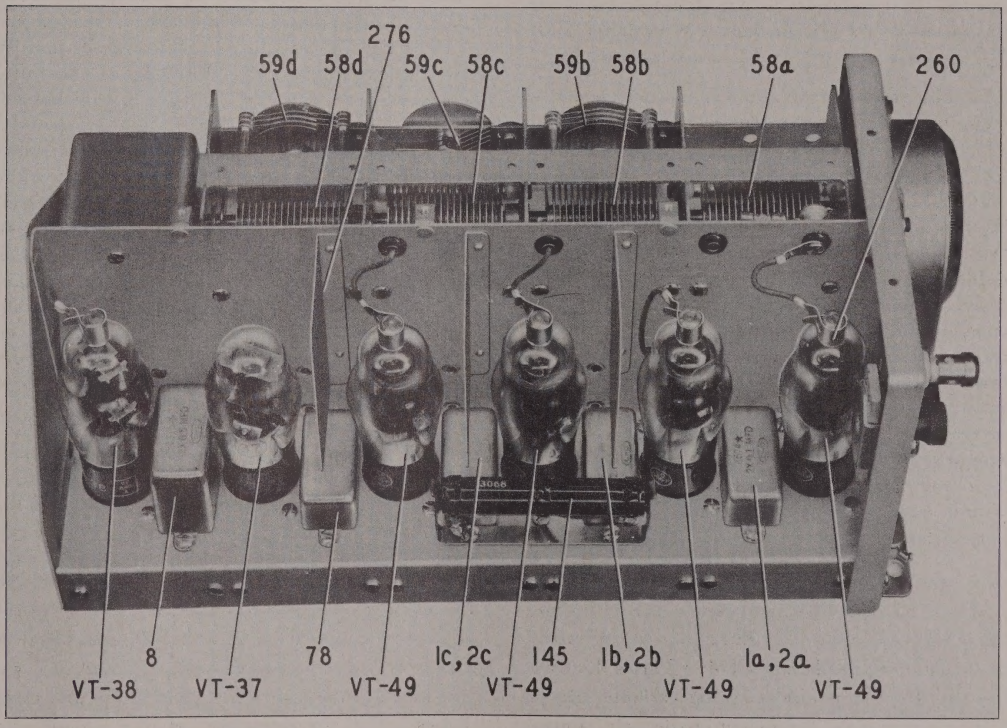


FIGURE 14 – RADIO RECEIVER BC-AS-229, SIDE VIEW

of the vacuum tube nearest the antenna is greatest at the low-frequency end of each frequency band.

The capacities of the equal section of the gang capacitor 58, which tune the coupling coils 90 to resonance with each other, and with the incoming radio signal, are augmented by the aligning capacitor 59. These aligning capacitors are built into the respective sections of the gang capacitors, and are separately adjustable. The function of capacitor 59 is two-fold; first, to compensate in all frequency bands for slight inequalities in the residual capacity of each stage; second, to provide a relatively high capacity in each tuned stage following the antenna stage.

After successive amplification through the four Tubes VT-49, the incoming radio signal is impressed across resistor 68 and the last tuned coil 90c, between the cathode and the grid-plate anode of the detector. This tube acts as a diode detector and develops across resistor 68 a pulsating d-c voltage which is the result of the rectification of the incoming carrier, and causing a varying current flow through 68 at an audio frequency. The audio-frequency signal voltages are impressed on the grid of the audio amplifier Tube VT-38, through resistor 72 and capacitor 11.

This tube amplifies the audio signal, which passes from its plate through the primary of transformer 71. A low-pass filter section, comprising choke coil 94 and capacitors 9, is connected to the secondary side of transformer 71. The low-pass filter attenuates all audio frequencies above 3,000 cycles per second; it is included in the circuit to reduce audio "noise" occurring at the higher audio frequencies. Transformer 71 is a stepdown transformer, and the output terminal 55, of the receiver is connected through the filter to the low-impedance side of this transformer. The receiver is designed for use with Headset HS-18 or Headset HS-23. Resistor 72 is a filter resistor operating in conjunction with capacitor 12 to keep radio-frequency currents out of the audio output stage; resistor 70 is a grid return for the output Tube VT-38.

The sensitivity of the receiver is controlled by varying the grid bias, and hence the radio frequency amplification of three of the radio-frequency amplifying Tubes VT-49. This is done externally, by a manually operated variable resistor 131, or internally, by an automatic gain control circuit. The grounded lines and points form the common return circuit of all supply and bias voltages. The cathodes of the first three radio tubes are connected for direct current to terminal 46 of the power plug. The grids of the first two tubes are connected to terminal 54 of the power plug, as well as to a line running to the detector circuit. If terminal 54 is grounded externally at switch 134 (MAN.), thus completing all grid circuits to ground, the external resistance 131 between the cathodes (terminal 46) and ground will limit or control the amplification of the first three tubes by making the grids more negative with respect to the cathodes. If terminal 46 is grounded externally at switch 134 (AUTO.) bringing all cathodes to ground, a d-c voltage between terminal 54 and ground will determine the grid bias and hence the amplification of the first two tubes. Such a voltage is developed automatically, when terminal 46 is grounded externally, by rectification of the incoming carrier wave at the detector Tube VT-37. This d-c voltage, which appears across the output resistor 68, of the detector, is approximately proportional to the amplitude of the incoming carrier, owing to the characteristics of the two-electrode detector. This voltage is fed back through resistors 69 and 99 to the grid circuits of the first two tubes. Resistors 69 and 99 and the two capacitors 4 form a low-pass filter which suppress from this automatic gain control line, all of the audio-frequency signal voltage developed by the detector across resistor 68, leaving only a direct-current voltage between the grids of Tubes VT-49 and ground. This direct-current voltage biases the grids of the first two Tubes VT-49 more and more negatively with respect to their respective cathodes as the incoming signal increases. The radio-frequency amplification is decreased as the radio-frequency signal increases, and the signal output of the receiver is thus held substantially constant over a wide range of incoming signal strengths.

Terminal 45 of the power plug and receptacle is a positive 12-14.25 volt terminal, and is connected within the receiver to the heaters of the six vacuum tubes, which are arranged in a series-parallel circuit. The cathode of the output Tube VT-38 is connected through bias resistors 88 and bypassed by capacitors 8 and 6 to provide for the control grid of this tube a 25-30 volt negative bias with respect to this cathode. A residual negative bias is imparted to the grids of the first three Tubes VT-49 by including between ground and their cathodes two resistors 61g and 98. Terminal

47 of the receptacle is left blank in this receiver. Resistors 61b, d and capacitors 1a, b, c, are "decoupling" filter elements used to reduce radio-frequency interaction between the several stages. Terminal 56 is a high-voltage terminal supplying the plate circuits of Tubes VT-49 tubes and the screen of Tube VT-38. Resistors 61a, c, e and capacitors 2a, b, c, 78 are decoupling filter elements. Resistor 61f is used to prevent noise, which may be picked up in the interconnecting cables, from reaching the grid of the first amplifier tube. Terminal 57 is a second high-voltage terminal feeding the plate of Tube VT-38.

Terminal 55 is connected externally to the telephone receivers. The screen grids of the first three Tube VT-49 are supplied with voltage from a tap on the voltage-divider resistor 145. The screen grid of the fourth Tube VT-49 is operated at the same voltage as the plate of this tube.

A two-element gaseous (neon) bulb, 87, is permanently connected in parallel with the secondary winding of the first radio-frequency transformer 89 in the antenna stage. This bulb is a voltage limiting device designed to protect the amplifier from damage if it is tuned to the frequency of a transmitter within very close range. The bulb 87 ionizes at a voltage of about 75 volts and a current flow occurs which effectively short-circuits the input stage of the amplifier, but only so long as the high incoming voltage is present.

Capacitor 79 is a small fixed capacitor permanently connected across the primary terminals of the first tuned radio-frequency transformer to compensate, in tuning alignment, for the inter-electrode tube capacities present across the primaries of all other radio frequency transformers. The various pairs of spring contacts are mounted about the circumference of a circle and are fixed with respect to the frame of Radio Control Box BC-AS-231. The studs are mounted in a similar circle upon the rotatable member of the switch, and short-circuit the respective pairs of spring contacts as they rest between them. The switch member upon which the studs are mounted is rotated by means of the handle 263. In Figure 19, the rotatable member of the switch is shown as a circle and pointer. The studs,

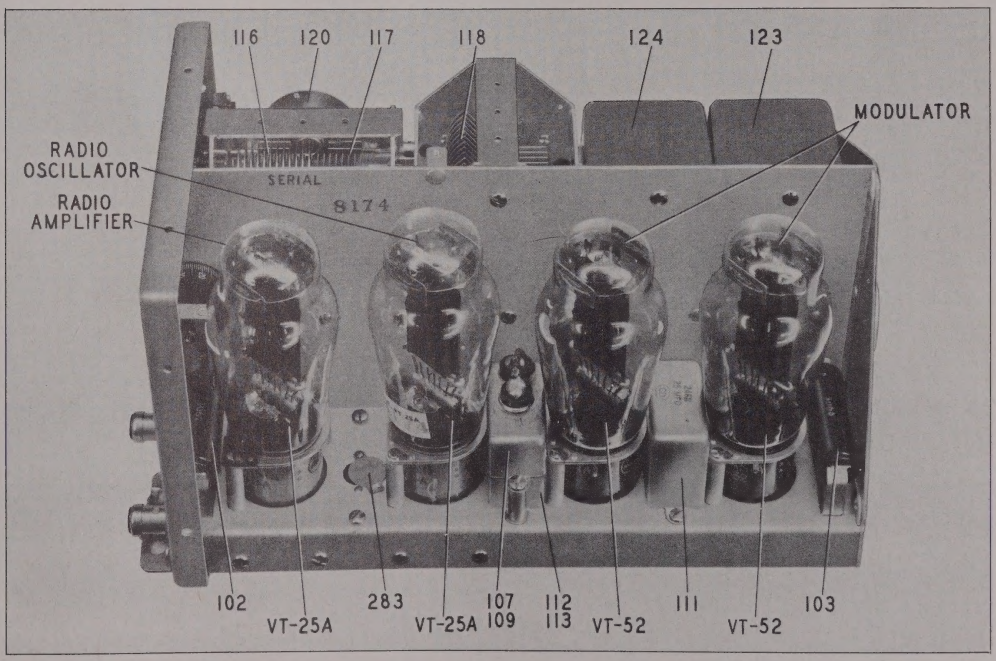


FIGURE 15—RADIO TRANSMITTER BC-AS-230, SIDE VIEW

indicated by black circles, are to be considered as rotating with the switch member between each of the three positions, and the contact springs are fixed with respect to the remainder of the diagrams. In Figure 17 the connections which are made by the studs and springs contacts are indicated by the arrows marked Switch 134. These are to be considered as all moving simultaneously between the three switch positions.

13. RADIO TRANSMITTER BC-AS-230 AND TRANSMITTER COIL SETS

a. General

Electrically, the transmitter comprises a radio-frequency oscillator, a radio-frequency amplifier, a coupling circuit for transferring radio-frequency power from the amplifier to the antenna, and a modulator stage for amplfying either internal or external modulation currents and modulating the radio frequency amplifier. The radio oscillator and radio amplifier are Tubes VT-25-A. The modulators are Tubes VT-52. See Figure 18.

b. Detailed

The radio oscillator circuit comprises a shielded coil assembly 122 having three windings, a, b and c, variably tuned by capacitor 116, which is operated by the frequency control knob 241 and carries dial 242. This control knob drives the capacitor shaft through a worm gear.

The dial is graduated in equal divisions from 0 to 30, each division corresponding to one rotation of the knob 241, which itself is graduated 0 to 100. Capacitor 117 is a fixed air capacitor, connected in shunt with 116 and mounted in the same frame. The oscillator has a grid resistor 105 and a grid capacitor 114. Capacitor 120 is a small variable air trimmer capacitor also mounted in the same frame and adjustable with a screwdriver through an aperture under the capacitor cover 288. The function of this capacitor is to compensate for small changes in the fixed capacity of the oscillator if tubes are changed. The oscillator is coupled to the grid of the amplifier tube through a third coil, c, of

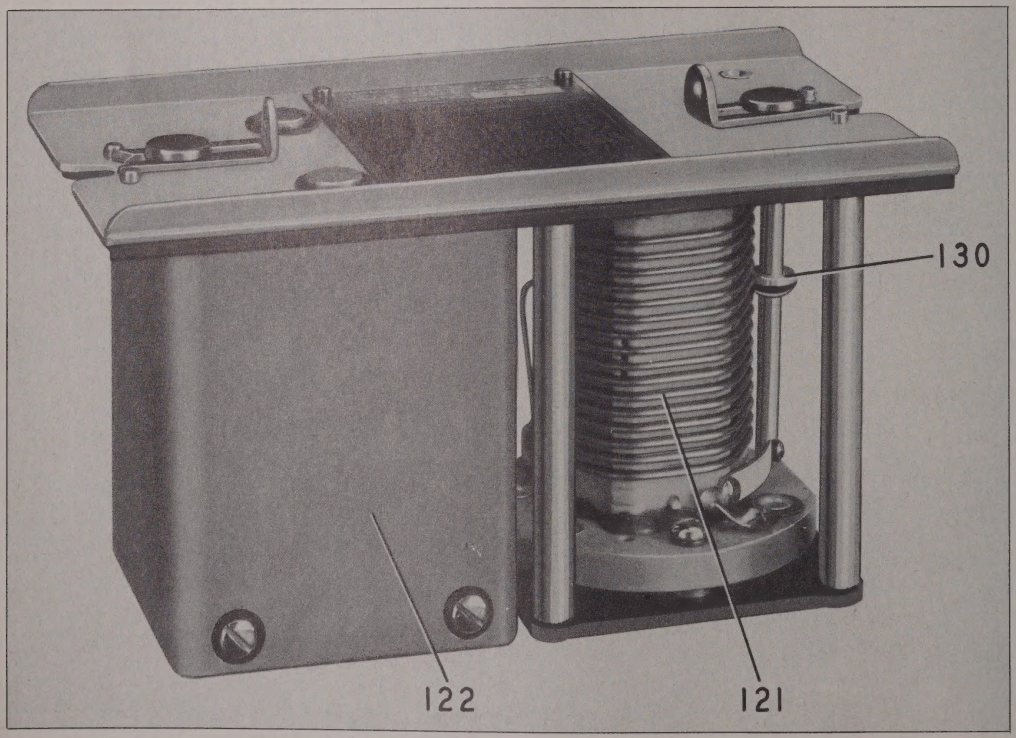


FIGURE 16—COIL SET C-435 (TRANSMITTING)

assembly 122. Resistor 126 is a small cartridge resistor mounted inside the shield of coil assembly 122. Its function is to equalize the amplitude of oscillation throughout the frequency band identified with a particular coil set. Grid bias is generated for the VT-25-A amplifier tube and the two modulator Tubes VT-52 by the flow of rectified grid current through resistor 104 bypassed by capacitor 113. Capacitor 119 is a leaf-type mica capacitor used for balancing out the grid-plate capacity of amplifier Tube VT-25-A. The amplifier plate feeds coil B, of shielded coil assembly 121 which is the second element of the transmitter coil set. Coil C of assembly 121 is a coupling winding for the balancing capacitor 119. In parallel with a portion of the antenna winding, a, is the variable capacitor 118, which may be adjusted by knob 243.

The capacity of this capacitor decreases in the direction of the arrow on the knob. The antenna binding post is connected to the coil through ammeter 129 by the adjustable tap arm 130. 110 is a by-pass capacitor, comprising two series sections 110a and 110b. The plate of the radio amplifier tube may be supplied with d-c voltage through the winding 3-4 of modulation transformer 124 by external connection between terminal 20 and terminal 22. This connection is made when control switch 141 is set on VOICE or TONE. It is supplied with d-c voltage direct from the high-voltage terminal 21 by external connections of 20 to 21. This without including a winding of the modulation transformer in its plate circuit. This connection is appropriate for the transmission of CW signals and is made when control switch 141 is set on CW. Resistor 103 is merely a load resistor for the secondary winding 3-4 of the modulation transformer 124. When 20 is externally connected to 21 for the transmission of unmodulated CW signals, resistor 103 is shunted across the modulation transformer, and the power and side-tone levels in the transmitter are thereby maintained undisturbed. The radio oscillator is supplied with d-c plate voltage by permanent connection of its plate circuit through the voltage dropping resistor 102 to terminal 21. 112 is a by-pass capacitor. The two modulator Tubes VT-52 are connected in parallel to modulate by plate-voltage variation the single Tube VT-25-A radio amplifier. 125 is a tone oscillator coil assembly and 123 is the microphone or modulator-grid transformer.

The modulators obtain plate voltage through windings 3-4 of 125 and 1-2 of 124, from terminal 21. Grid bias is obtained for the modulators by the connection of their grid circuit through the filter resistor 100 to the d-c negative side of resistor 104. External modulating (microphone) currents are brought into the transmitter from terminal 33 through winding 1-2 of transformer 123, the secondary, 3-4 of which, feeds the modulator grid circuit. The function of the top section of control switch 141, shown in Figure 18 is to short-circuit the microphone in the CW and TONE positions. 34 is a positive 12-14.25 volt terminal. When the microphone is connected externally between 33 and ground, the positive terminal 34 supplies a d-c polarizing potential of 2-7 volts through the small drop resistor 101. Any audio-frequency currents in the modulator grid circuit are amplified and transmitted to the plate circuit of the radio amplifier tube through the modulation transformer 124. These modulating currents also flow through winding 3-4 of the tone oscillator coil 125. Terminal 32 is a short-circuiting terminal for the tone oscillator coil assembly, which is effectively removed from the circuit if terminal 32 is grounded externally. If terminal 33 is grounded externally, no external modulation currents can reach the radio amplifier. When this external connection is made, the transmitter is adapted for the transmission of either tone-modulated signals or unmodulated signals.

In this condition, the modulators may be made to oscillate at a tone frequency (about 1,000 cycles) by opening terminal 32 externally (CW and TONE positions of switch 141). This tone oscillation is generated as follows: winding 3-4, of tone oscillator coil 125 is connected in the plate circuit of the modulators. Winding 1-2 is coupled in the correct sense to 3-4 to produce self oscillation if terminal 2 is connected to the modulator grids. This connection is effectively made by capacitor 106. Transformer 123 has no function when the modulators are set for tone-oscillation, and it is effectively removed from the circuit by: (a) short-circuiting the primary 1-2 by grounding terminal 33 externally; (b) the connection of resistor 115 across the secondary 3-4 of 123. This resistor is small enough to allow the grids to be adequately excited for self oscillation through capacitor 106, but sufficiently large so that it does not hinder the operation of 123 as a microphone transformer. The modulators will oscillate, as described when switch 141 is set on either CW or TONE. For tone transmission, the secondary 3-4 of the modulation trans-

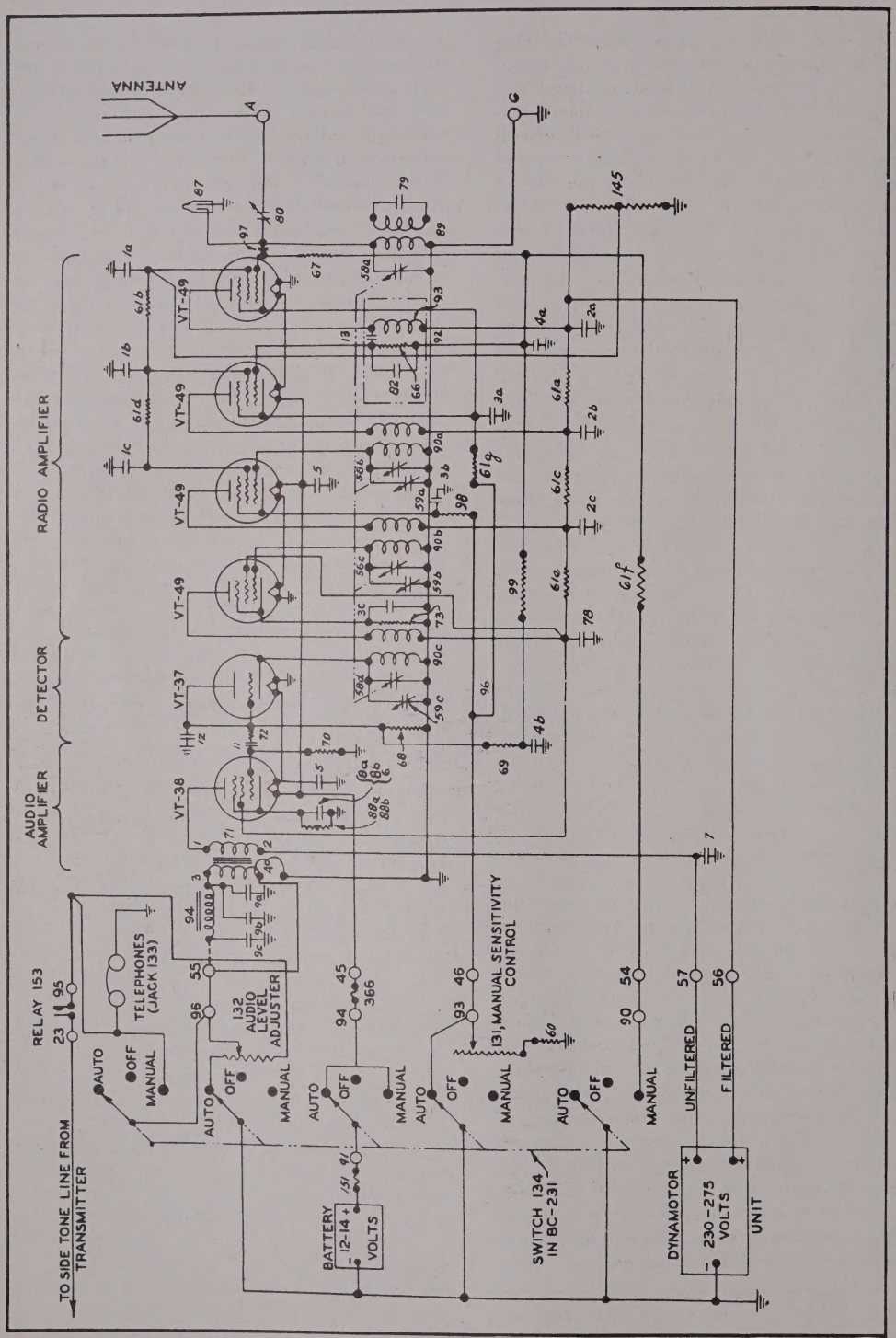


FIGURE 17—RADIO RECEIVER BC-AS-229, FUNCTIONAL DIAGRAM

former is connected in the plate circuit of the radio amplifier tube through the external connection of terminal 20 to terminal 22. For CW transmission, terminal 22 is left open and 20 is connected direct to the high-voltage terminal 21, thus cutting the modulation transformer out of this radio amplifier circuit. A low-impedance, tertiary winding on transformer 124, connected between ground and terminal 23, supplies sidetone to the external circuits.

It has a high tap 7 and a low tap 6, giving a choice between two levels of sidetone. If a telephone circuit is externally connected between 23 and ground, it will receive audio voltage corresponding to any audio current flowing in the plate circuit of the modulators, regardless of whether this current is produced by external voice modulation or internal tone oscillation. Since the modulators oscillate when CW signals are transmitted, a tone-frequency side-tone is supplied to terminal 23 during CW transmission. 109 is a by-pass capacitor and 111 is a filter capacitor of high capacity. The function of 111, working in conjunction with dropping resistor 101, is to filter from the microphone line (terminal 33) any ripple voltage which may be present in the 12-14.25 volt source connected to terminal 34. The filaments of all four tubes are connected between 34 and ground so that the parallel modulator tubes both operate at the same bias with respect to their filaments. A section of switch 134 is shown in Figure 18 because this particular section makes and breaks the circuit between the transmitter filament terminals 34 and the primary 12-14.25 volt source. All other switches shown in Figure 18 are sections of switch 141 in the transmitter control box. 127 is a closed-circuit jack in the common d-c plate circuits of the modulator and radio oscillator tubes. 128 is a closed-circuit jack in the d-c plate circuit of the radio amplifier tube.

14. RADIO CONTROL BOX BC-AS-231

This unit is designed for remote control of the electrical power and amplification circuits of the receiver. Terminal 95 of receptacle 167 is wired to the tip contacts of the two telephone jacks adapted to receive Plug PL-47, Plug PL-55, or equivalent, and also to one fixed terminal of variable resistor 132. Terminal 93 is connected to the switch and to the manual gain-control resistor 131. Terminals 90, 91 and 94 are connected to the switch. Terminal 92 is grounded to the case. Terminal 96 is connected to the sliding contact of resistor 132 and also to the switch. Variable resistor 132 is an audio-frequency level adjuster which is connected between 95 and a section of the switch which grounds the low end of 132 in the AUTO. position only. Resistor 60 is connected in series with variable resistor 131 to give a fixed residual bias to the control grids of the first three tubes. Resistors 131 and 132 are varied simultaneously by a single shaft which is rotated by knob 265. This knob is, in both operating positions, a volume control knob controlling the receiver output. In the MANUAL position of the switch, it controls the volume by varying the fraction of the receiver output, from 96, which is impressed upon the telephone jacks 133. The contact portions of switch 134 consist of a group of spring contacts arranged in pairs, associated with a group of short-circuiting studs.

15. ANTENNA SWITCHING RELAY BC-AS-198

The function of this relay is to switch a common antenna between receiver and transmitter in installations where one antenna is used for both receiving and transmitting. The antenna binding post is connected to the movable contact of one relay element. See Figure 19. When the relay is non-energized, this movable contact rests on a fixed contact which is connected to the REC. binding post. When the relay is energized, this movable contact is brought to a second fixed contact which is connected to the TR. binding post. In addition, the relay has an independent pair of contacts which are open in the non-energized REC. position and which ground the receiver binding post in the energized TRANS. position. The coil of the relay is connected through Cord CD-137, across the coil of the power relay 153 in the junction box so that both relays are energized simultaneously by the key on Radio Control Box BC-AT-232, the microphone switch, or a remote switch. The changeover between receiver and transmitter thus causes power relay 153 and the antenna switching relay to perform simultaneously the respective functions of switching the dynamotor voltage between the receiver and transmitter and switching the antenna between receiver and transmitter.

16. DYNAMOTOR UNIT BD-AS-83

See Paragraph 5g for a description of Dynamotor Unit BD-AS-83 also see Figure 19. Terminal 38

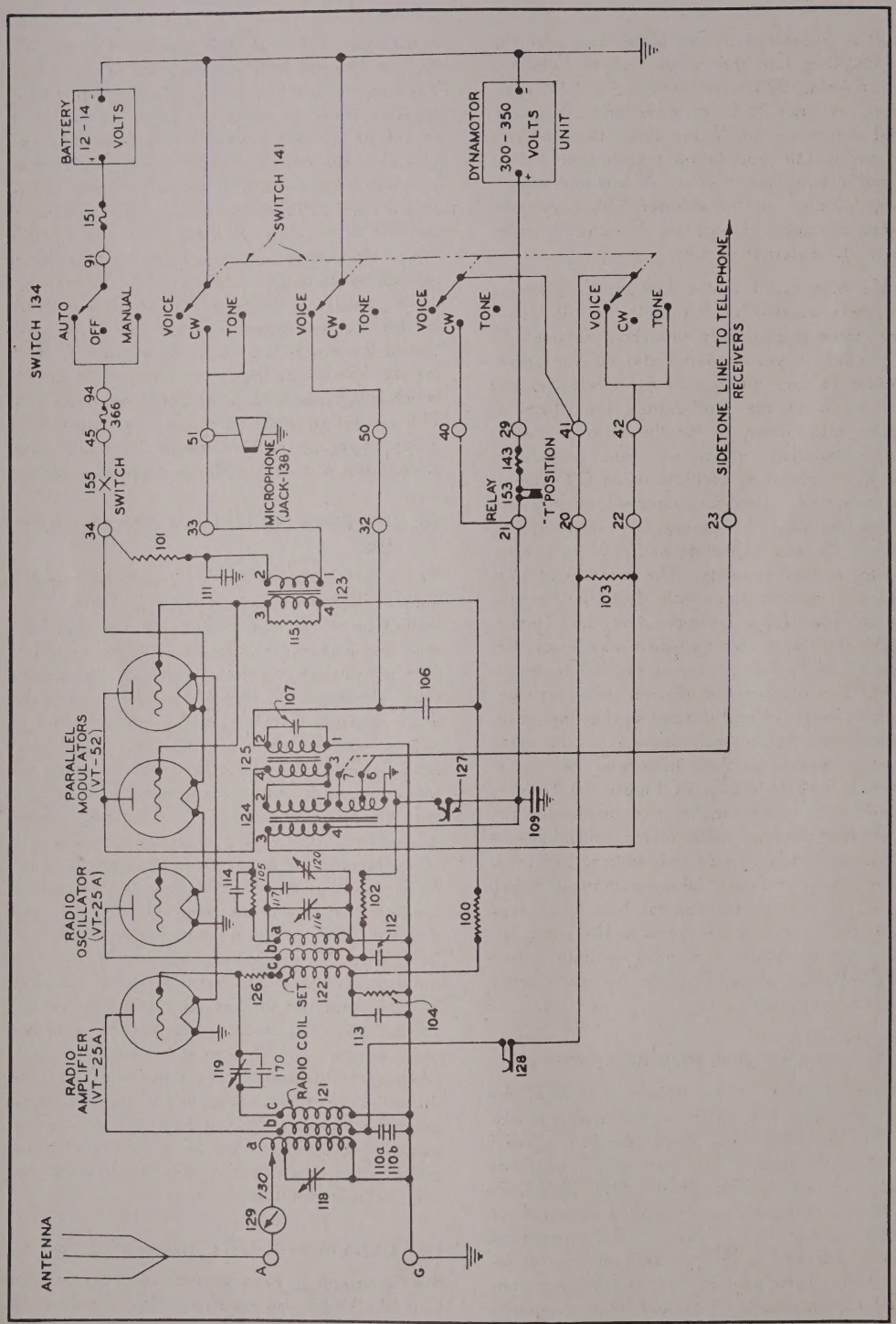


FIGURE 18—RADIO TRANSMITTER BC-AS-230, FUNCTIONAL DIAGRAM

of the power plug is a positive 12-14.25 volt supply terminal and is wired through radio-frequency choke 149 to the low voltage commutator.

Choke 149, and the capacitor section 147a shunted across this commutator form a filter section to suppress radio-frequency disturbances from this supply line. The high-voltage commutator feeds terminal 31 through filter resistor 146; the high-voltage output is also led through the low-pass audio filter section comprising iron-core choke 148 and two capacitor sections 147, b, c, to terminal 29. When terminal 29 is externally connected to terminal 30, the drop resistor 152 is in series with the high-voltage output 39. Three capacitors 147 are mounted together in one metal case.

17. COIL SET C-436 and COIL SET C-437

Each of these receiver coil sets comprises four tunable radio-frequency transformers, 89, 90 and one band-pass coupling unit, 92. When a dual coil unit is plugged into the receiver, the circuit connections between all coil terminals and the corresponding terminals of the receiver are, for both positions of the band-change switch, exactly the same as for a single coil set. In order to operate this switch, and throw it between the HIGH and LOW bands it is necessary to attach to the outlet 287 either Control Unit MC-137 or Control Shaft MC-134 and Control Unit MC-135.

18. RADIO CONTROL BOX BC-AT-232

Terminal 51 of the plug receptacle is wired to the ring contact of the microphone jack 138, which accommodates Plug PL-68 or equivalent. The sleeve contact of the jack 138 is grounded. The tip contact is connected through terminal 48 to power relay 153 and the antenna switching relay. Telegraph key 139 also closes the circuit between terminal 48 and ground. Adjusting screw 142 may be used to adjust the spacing between the key contacts. It may also be used to lock the key closed for test purposes. Terminal 52 is grounded and the remaining terminals are connected to various contact springs of the switch 141. The construction and operation of this switch is similar to that of switch 134 in Radio Control Box BC-AS-231, in which the short-circuiting studs are mounted on a member rotated by the switch handle, and stop between the various pairs of spring contacts. Jack 140 is an extra, two-way outlet connected in parallel with key 139, for use with an external key if desired.

19. COOPERATION OF UNITS

In an operating installation where the various units are connected through cords to the junction box and the 12-14.25 volt source as indicated in Figure 20 to form a complete Radio Set SCR-AS-183, the circuits of the whole system are interconnected as shown in Figure 19. Each terminal in the junction box is connected through a cord to the terminal bearing the same number on one of the operating units; each of the numbered dots in Figure 19, except 43 and 44, refers to two correspondingly numbered terminals, one on the junction box and one on an operating unit.

The numbered circles in Figures 17 and 18 represent the same correspondingly numbered terminals. The following discussion may be read in connection with Figures 17, 18 or 19.

Switch 155 in junction box completes the 12-14.25 volt supply line from Radio Control Box BC-AS-231 to both receiver and transmitter in the TRANS. REC. position and cuts off this line to the transmitter for the purpose of saving power in the REC. ONLY position.

Current is drawn from the 12-14.25 volt source through the positive supply line from terminal 44, through fuse 151 and terminal 91 to Radio Control Box BC-AS-231. When the control box switch 134 is in OFF position this line through 91 is open and there is no voltage on the dynamotor unit, transmitter, or receiver for any position of the other controls. With this switch at MANUAL or AUTO. high voltage from the dynamotor unit, at terminal 29 may be impressed upon either the receiver or the transmitter (but not both at once) depending upon the position of the junction box relay 153. The coil of this relay is supplied with low voltage d-c from terminal 45, and the circuit is completed to ground independently through each of three manual controls. When this circuit from the relay coil is closed to ground the relay armature throws to the right (Figure 19) and high voltage terminal 29 is fed to the transmitter. When this circuit is open the relay armature drops back and terminal 29 is connected through drop resistor 152 to the receiver, terminal 56; at the same time a second pair of relay terminals disconnect the low-impedance, side-tone winding from across the telephone receivers in Radio Control Box BC-AS-231.

For remote switch control of this throw-over operation, Cord CD-136, should be plugged into receptacle 172 and the other end of this cord terminated in a suitable airplane switch (not a part of Radio Set SCR-AS-183). The same operation is performed by operating a microphone switch connected between ground and the tip contact of jack 138 or by operating the telegraph key.

Terminal 57, feeding the plate of Tube VT-38, is energized at all times from terminal 31 of the dynamotor.

When relay 153 is in the "receive" position the circuits of the receiver are controlled as follows. With Radio Control Box BC-AS-231 the supply voltage is impressed through terminals 91, 94, 38 upon the dynamotor, and through 91, 94, fuse 366, and 45 upon the heaters of all the receiving tubes. The receiver voltage divider 145, energized from terminal 39, feeds high voltage to the plates of Tubes VT-49 and screen of Tube VT-38; and lower voltage is supplied to the screen grids of Tubes VT-49. High voltage from terminal 31 is fed through filter resistor 146 to the plate of Tube VT-38. Telephone receivers at jacks 133 are connected to the output circuit of Tube VT-38. Variable resistor 132 in the control box is open-circuited and variable resistor 131, in series with fixed resistor 60, is connected between ground and the cathodes of the first three Tube VT-49, through terminals 93 and 46. Variation of this resistance by rotating the knob 265 varies the gain of the radio amplifier. The receiver sensitivity increases in the direction of the arrow engraved on this knob which is the direction of decreasing resistance.

The automatic-gain control action is suppressed in this position of switch 134 by grounding the grid circuits of the first two Tube VT-49 through terminals 54 and 90. With Radio Control Box BC-AS-231 switch at AUTO., the dynamotor and receiver power circuits are energized as in the MANUAL position. But in the AUTO. position the manual gain-control resistor 131 is short-circuited to ground, thus grounding the cathodes of the first three Tube VT-49. The grid circuits of the first two Tube VT-49, connected to terminal 54, are disconnected from ground, and the gain control voltage developed by the detector across resistor 68 controls the bias, and hence the amplification of these tubes. Resistor 132 is employed as a voltage divider, with the end terminals connected to the telephone receivers and the receiver output line through 55 and 96 connected to the sliding contact controlled by knob 265. Rotating the knob in the INCREASE direction slides the receiver output line up this resistor and thus impresses more signal voltage upon the telephones. The sidetone voltage from terminals 23 and 95, is practically independent of the setting of the level-setter 132, regardless of the number of phones connected in parallel at jack 133. Rotation of the knob 265 has no effect upon the sensitivity of the receiver, which automatically decreases as the incoming radio signal increases and vice versa. Resistor 132 is placed in the circuit in the AUTO. position of the switch because a suitable level of audio signal output cannot be permanently predetermined, but depends upon the external noise and the aural acuteness of the operator.

The automatic gain-control circuit of the receiver is so designed that the controlled signal output is too great for suitable reception with knob 265 in its maximum INCREASE position, except under the most unfavorable conditions.

When relay 153 is in the transmit position the high voltage is cut off the screen grids of all receiving tubes and the plates of Tubes VT-49 and for any position on Radio Control Box BC-AS-231 other than OFF the circuits of the transmitter are controlled as follows: At all three positions of switch 141 on Radio Control Box BC-AT-232, terminal 34 supplies 12-14.25 volt to the filaments of all transmitter tubes. At all three positions of switch 141 the modulator and radio oscillator tubes are supplied with high voltage from terminal 21 and the radio amplifier tube is supplied with high voltage, either from terminal 21 through the modulation transformer, or from terminal 20 direct. At the VOICE position of switch 141, terminal 32 is grounded, preventing tone oscillations in the modulator stage; any modulating voltage impressed at 51 in Radio Control Box BC-AT-232 passes through microphone transformer 123, modulator Tubes VT-52, and modulation transformer 124 to the plate circuit of radio amplifier Tube VT-25-A modulating the output of the transmitter. At the TONE and CW positions of the switch 141 terminal 32 is ungrounded, and the modulator tubes generate tone oscillations.

At the TONE position, terminal 20 is connected to terminal 22, and audio voltage from the modulator stage is impressed through the modu-

lation transformer 124 in the plate circuit of radio-amplifier Tube VT-25-A. At the CW position, terminal 20 is disconnected from 22 and high voltage is impressed on 20 direct from 21 through 40 in Radio Control Box BC-AT-232. The modulator stage still generates tone frequency for use in providing side-tone, when the key is pressed, but the emission from the amplifier stage is unmodulated. At all switch settings on Radio Control Box BC-AT-232, side-tone voltage is fed from terminal 23 through relay 153 and 95 to the telephone receivers at jack 133.

The only element of Antenna Switching Relay BC-AS-198, which is connected into the junction box is its coil. This coil is connected through Cord CD-137 and Plug PL-77, in parallel with the coil of the power relay 153. When the power relay is thrown between T and R (Figure 18) the movable contacts of the relay are thrown between TRANS. and REC.

Radio Set SCR-AS-183 is set for receiving at all positions of the control box switches, except when either the microphone switch, a switch on Cord CD-136, or a key, is closed.

SECTION IV

MAINTENANCE

20. PRE-FLIGHT INSPECTION

Radio Set SCR-AS-183 must be given a pre-flight inspection before every radio flight, according to the following routine:

See that the proper coil set is in Radio Receiver BC-AS-229.

Examine tubes in both Radio Receiver BC-AS-229 and Radio Transmitter BC-AS-230. Be sure that each tube is in the socket marked for that type and that all control grid clips are attached. Push each tube all the way into its socket. BE SURE THAT ONLY THE TRANSMITTING TUBES HAVING WHITE BASES ARE IN THE SOCKETS MARKED VT-25-A and that the proper tube is in the radio oscillator socket. See Paragraph 5K.

Inspect all snapslides and see that each plug is locked in its receptacle.

Check operations of switch controls. Set controls at MANUAL and RECEIVE and be sure that Radio Receiver BC-AS-229 is operating. Listen for dynamotor noise with volume control advanced to maximum.

Dynamotor noise should be negligible.

Check receiver input alignment by tuning in a weak signal and varying the position of knob 244 to make sure that the input circuit is tuned to resonance.

Turn up the engine past the speed at which the charging generator cuts in and check ignition and generator noise.

Check telephone cord and telephone plug for open or intermittent contacts. Check telephone receivers.

Set switch on Radio Control Box BC-AT-232 at VOICE and note transmitter current reading. Modulate Radio Transmitter BC-AS-230. If the transmitter is operating properly the antenna current will increase with the modulation. Note side tone in telephone.

Measure supply voltage with the airplane engine running at least 1500 rpm.

DO NOT ALLOW RADIO EQUIPMENT TO BE OPERATED IF THIS VOLTAGE IS LESS THAN 12 VOLTS OR MORE THAN 15 VOLTS.

NOTE: Never operate Radio Set SCR-AS-183 on the ground longer than is necessary to complete this inspection. Never leave the airplane without turning the switch on Radio Control Box BC-AS-231 to OFF.

21. SERVICE INSPECTION

a. General

Check airplane battery with hydrometer.

Check operation of voltage regulator of charging generator, adjusting it to assure consistent operation of generator at 12 to 15 volts.

Using a high-resistance voltmeter, measure voltages to ground of the various terminals in junction box as listed on page 44. Satisfactory operation cannot be expected unless these voltages are all within 10 per cent of their rated values.

Check bonding of cables and contacts between antenna and ground wires and their respective binding posts on Radio Receiver BC-AS-229 and Radio Transmitter BC-AS-230.

Clean all antenna insulators, particularly those which are exposed to the engine exhaust, and check contacts on the lead-in insulators.

b. Notes on Dynamotor Unit BD-AS-83

If the receiver is operating satisfactorily with dynamotor noise at a suitably low level do not touch Dynamotor Unit BD-AS-83. When this machine is in proper condition, manipulation of the brushes or commutators is apt to do more harm than good. The dynamotor may require lubrication about every 300 hours of operation. Lubricate Dynamotor Unit BD-AS-83 at these intervals with a light ball bearing grease. Access to the bearings is obtained, when necessary, by removing the end covers P-3391 held by screws P-3596. Do not put much lubricant in these bearings. Do not use vaseline or any other lubricant not specially prepared for ball-bearings, or the machine will not turn over. G. E. Ball-Bearing Grease is recommended for use in dynamotor ball bearings. If rough turning or excessive looseness is noticed after bearings are cleaned and greased, the dynamotor should be replaced and the unsatisfactory one should be shipped to a depot for repairs. No attempt should be made to replace dynamotor bearings

except at authorized repair shops. Never allow oil or grease to get on the commutators of the dynamotor. Remove dirt, grease or oil from the commutators with a clean dry cloth.

DO NOT USE SANDPAPER OR EMERY CLOTH ON EITHER COMMUTATOR. In time the commutators will be covered with a dark or semi-transparent film which is not a cause of noise and should be preserved thereon. The only other parts that are apt to require replacement during the life of the machine are the high-voltage brushes P-3679-E and P-3680-E. Removal of the end covers P-3391 gives access to the brushes. To remove a worn brush, unscrew the brush cap P-5009 which frees the brush and spring assembly. Be sure that the new brush is installed with the polarity marking on the upper side. New brushes on both commutators must be run in by operating the machine at normal load for several hours before placing in service. Proper brush seating is essential for satisfactory operation. A dynamotor with new brushes will be noisy and inefficient until brushes are properly run in.

22. REPLACEMENT OF TUBE VT-25-A IN RADIO TRANSMITTER BC-AS-230

Radio Transmitter BC-AS-230 is calibrated for use with a particular Tube VT-25-A in the radio oscillator socket. See Paragraph 6b.7. Whenever it becomes necessary to replace Tube VT-25-A in the radio oscillator socket follow the instructions given below.

Use a frequency standard, consisting of a crystal-controlled, or otherwise stabilized oscillator, of which the frequencies are known with a maximum error not exceeding 0.05%. A wavemeter or calibrated receiver is useless for this purpose. The frequency meter must be of the type which emits oscillations of a known frequency. Set this standard oscillator at 7,700 kc, using Coil Set C-435 in the transmitter. If 7,700 kc is not a standard frequency, select a frequency either between 7,000 and 7,700 kc or near the upper end of the 5,000-6,200 kc band. Provide a separate receiver, for listening in, tuned to the known frequency of the standard oscillator, or if provision is made for the use of head-phones on the standard oscillator, listen in at that point. Provide several Tube VT-25-A from which to pick a new oscillator. (Not all Tube VT-25-A may be used in restoring the original calibration, even though they may all be entirely satisfactory otherwise). Try various Tube VT-25-A successively in the oscillator socket, setting the transmitter frequency of the standard keeping the antenna circuit tuned to resonance. Note the frequency dial reading for zero beat, with each oscillator tube. Note the dial reading of the calibration chart, corresponding to the frequency of the standard. Select the tube for which the zero-beat dial reading is the closest to the dial reading of the calibration chart. In no case is a tube to be used as an oscillator if the zero-beat dial setting differs by more than about 30 scale divisions from the dial setting given on the chart for that frequency. With the selected tube in the oscillator socket, and the antenna circuit tuned to resonance, set the frequency control dial exactly on the setting given by the chart for the frequency of the standard source. Insert a screwdriver in the slotted shaft. Rotate this shaft slowly to right or left until zero-beat is obtained between the transmitter frequency and the oscillation of the standard source. The transmitter is then properly adjusted for continued use of the coil set calibration charts so long as the selected tube is used in the oscillator socket.

The following is an example of how the above process works in practice:

The frequency standard is set at 7,500 kc. Four Tube VT-25-A are available for use in selecting a new oscillator. The calibration dial setting for 7,500 kc in Radio Transmitter BC-AS-230 with its Coil Set C-435 is 2,440. With tube No. 1 as oscillator the transmitter zero-beats with the standard oscillator at dial 2,435; with tube No. 2 the transmitter zero-beats with the standard at dial 2,480; with tube No. 3, zero-beat is obtained at dial 2,460; with tube No. 4, zero-beat is obtained at dial 2,450. Tube No. 2 should not be used as an oscillator. Tubes No. 1, 3 and 4 may be used but tube No. 1 will give the most accurate results on future frequency settings from the chart, with tube No. 4 second best. Tube No. 1 is placed in the oscillator socket, the transmitter frequency dial is set at 2,440, the chart point; the trimmer capacitor 120 is adjusted to give zero-beat with 7,500 kc, and the calibration chart is used thenceforth throughout the life of this tube.

After oscillator tubes have been replaced more than once using the procedure outlined above, the trimmer capacitor may be appreciably offset from its original calibration position so that in selecting new oscillator tubes the comparisons with the original chart setting on the dial becomes

less significant. For this reason when it becomes necessary to place the oscillator tube, inspect the trimmer capacitor for position. Remove the transmitter cabinet and examine the variable plates (rotor) of the trimmer capacitor. This trimmer capacitor consists solely of the two variable plates and the two fixed plates which are mounted on the side of the frame of the main oscillator capacitor (116, 117, Figure 18). The original factory calibration was made with the trimmer at its mid-capacity position, i. e., with the straight edges of the semi-circular rotor plates perpendicular to the capacitor shelf. At the time of the second, third and subsequent replacements of the oscillator tube by the method described above, the rotor of the trimmer capacitor should be restored to its mid-capacity position before selecting the next oscillator tube.

After a tube has been selected and the transmitter has been adjusted as described above, attach a "sticker" to the selected tube with suitable notation thereon so that it will not be confused at a later time with the similar type of tube which is used as the radio amplifier tube.

23. TROUBLE LOCATION AND REMEDY

When looking for trouble always examine all the simple causes of failure first. Radio Set SCR-AS-183 is a complicated electrical system, depending upon precise design, workmanship and adjustment for its successful operation. Check all outside connections and parts first. Service failure may be due to a cable, a plug, a power supply or a tube. The following maintenance chart covers field inspection tests and bench tests.

MAINTENANCE CHART

FIELD INSPECTION

a. Radio Receiver BC-AS-229

Failure	*Conditions*	*Service Procedure*
A. No output	Equipment cabled and installed in plane; plane engine not operating	1. Check fuse 366 located in junction box 2. If dynamotor does not run check fuse 151; if fuse is satisfactory replace dynamotor 3. Be sure coil sets are firmly seated 4. Inspect headphone cord and jack for defective connection, substitute headset 5. Inspect Antenna Switching Relay BC-AS-198 for open contact or broken lead 6. If two tubes do not light, replace with tubes known to be good 7. Inspect cable connections for loose contact or broken pins 8. Inspect antenna and antenna lead in for breaks or short circuit
B. Low sensitivity		1. Inspect antenna insulators and lead in 2. Check antenna for broken lead 3. Check voltage of battery supply. Should be 12-14.25 volts d-c with load 4. Check antenna alignment 80 5. Replace coil set
C. Receiver noisy	Engine of plane not running. Radio receiver ON	1. Short antenna post to ground. If noise ceases, it is external interference or poor antenna contacts or insulation. If noise persists, replace dynamotor 2. Move and check all cords, cables, ground leads, bonding and coil set snap slides for poor contact 3. Vacuum tube noise can be located by replacing tubes one at a time
	Engine of plane running. Radio receiver ON	1. The above checks should be made, and in addition the plane generator should be checked. If noise stops or is reduced considerably with antenna post shorted to ground, possible additional filtering of the generator may be necessary. Place a 0.5 mfd capacitor between the positive field terminal of the plane's generator and ground. Use as short capacitor leads as possible.

MAINTENANCE CHART—Continued

FIELD INSPECTION—Continued

a. Radio Receiver BC-AS-229—Continued

Failure	*Conditions*	*Service Procedure*
D. Intermittent output	Engine running	1. Vibration of the plane's engine may cause certain poor contacts; the engine speed should be varied until the intermittent condition occurs most frequently 2. Check antenna and antenna lead in, cables, cord sets, and plug in coil sets for loose contact 3. Tubes should be replaced one by one with tubes known to be good
E. Oscillation	Variable pitched heterodyne is present when received signal is tuned in	1. Inspect tube cover snapslides for loose or dirty contacts 2. Check all screws on receiver set box, make sure they are tight 3. If oscillation persists, replace receiver

b. Radio Transmitter BC-AS-230

A. No output	Current indicator 129 shows no reading	1. Check fuse 366. If dynamotor does not run, check fuse 151. If fuses are good and tubes light but dynamotor does not run, replace dynamotor 2. Replace coil set 3. Check cables and connectors for open or shorted circuits 4. Check antenna connectors for open circuit 5. Replace tubes if they do not light. CAUTION:—Replacement of Tube VT-25-A, oscilator tube, may result in a change of calibration If abnormal, replace transmitter with one known to be good. See par. 22. 6. Check jacks 127 and 128 for current indications. If abnormal, replace transmitter with one known to be good
B. Erratic output	Fluctuation of antenna current meter on all types of emission	Probably improperly neutralized, replace transmitter with one known to be good
C. Output on CW and TONE	No voice modulation	Check microphone cord, substitute microphone

BENCH TEST

NOTE: Equipment under test is cabled and powered with bench test units.

c. Radio Receiver BC-AS-229

A. No output	Burned out or shorted tubes	Replace with tubes known to be good
	No plate voltage, Tube VT-38	Shorted 7, open 71 primary
	No plate voltage on any, Tube VT-49	Open primary 90a, 90b, 90c or open 61a, 61c, 61e; shorted 2a, 2b, 2c, shorted 78
	(NOTE: The above two points of voltage test indicate generally the condition of the B power distribution of the entire receiver)	
	Low plate voltage, 1st Tube VT-49	Shorted or partially shorted 2a, 2b, 2c, 78, 1a, 1b, 1c
	No screen voltage, 1st, 2nd and 3rd Tubes VT-49	Open 145, shorted 1a, 1b, 1c

MAINTENANCE CHART—Continued

BENCH TEST—Continued

c. Radio Receiver BC-AS-229—Continued

Failure	*Conditions*	*Service Procedure*
		NOTE: When all plate voltages are normal and there is no audio output, start at the grid of Tube VT-38 with an audio frequency signal from a standard signal generator. Check Tube VT-37 stage with this frequency, then with an r-f signal proceed stage by stage to the antenna circuit, applying the r-f signal to each VT-49 grid in succession.
	No coupling between antenna and 1st Tube VT-49	Open 97, shorted 87, broken lead
	No coupling from detector to Tube VT-38	Shorted 12, open 72, open 11, open 90c
	No coupling from Tube VT-38 to headphone channel	Open 71 secondary, shorted 9a, 9b, 9c, open 94
B. Low sensitivity	Voltages normal	1. Weak tubes should be replaced 2. Check antenna alignment 3. Align r-f stages 4. Check bias voltages of the r-f and audio tubes from cathode to grid. Open grid coils can be responsible for no output or low sensitivity NOTE: All readings of cathode bias voltages and supply voltages of the receiver is made with switch on MANUAL and the control grid of each Tube VT-49 connected to ground, with the control grid clips in place on their respective tubes. If this condition is not fulfilled, the set will oscillate since it is out of its shielding case and the voltages will be abnormal
C. Distorted output	Poor tone quality	1. Check for shorted or microphonic tube 2. Open 68 bias resistor 3. Shorted 8a, 8b, or 6 4. Open 88, 88b 5. Open 70
	Audio ripple or hum	1. Open 7 2. Open 12
D. Oscillation	Receiver heterodynes with incoming signal as set is tuned	Removal of shielding case can cause oscillation. With case securely fastened to the radio chassis, tighten all screws and clean snapslides for good contact. If condition persists, trouble can often be traced to: Defective tube Poorly grounded capacitor Open capacitors 1, 2, 3, 4, 5, 6, 7, 8 Abnormally high screen or plate voltage Low control grid bias

d. Radio Transmitter BC-AS-230

	A-55 required for following checks. See note	NOTE: Transmitter service requires the use of dummy antenna connected between antenna binding post and ground at all times. Recommended for this transmitter is the A-55 unit. If not available, substitute a 5 ohm, 10 watt resistor in series with 100 mmf capacitor. For low frequency use a 200 mmf capacitor in series with a 5 ohm resistor
A. No output	Tubes burned out or shorted	Replace with tubes known to be good
	Transmitter ON	Make current check at plugs 127 and 128

MAINTENANCE CHART—Continued

BENCH TEST—Continued

d. Radio Transmitter BC-AS-230—Continued

Failure	*Conditions*	*Service Procedure*
	Current at jack 128 too high	Check 110a, 110b for shorts or open circuit
	No current at jack 128	1. Check voltage at terminal 20. On CW transmission this voltage should be approximately 300 volts d-c 2. Open 121B 3. Broken lead in r-f plate current circuit
	Current at jack 127 too high	1. Check for shorted capacitor 112 2. Open 105 3. Open 100
	No current at jack 127	Check for open lead Shorted 109
	High current at jacks 127 and 128	Transmitter improperly neutralized. See page 41
	No plate voltage on Tube VT-25-A r-f amplifier	Replace coil sets 121-122 Defective 128 contacts
	No plate voltage on Tube VT-25-A oscillator	Replace coil sets 121-122 Open 102, shorted 112, shorted 109
B. Oscillator not functioning	High plate current in Tube VT-25-A r-f amplifier measured at jack 128	1. Defective Tube VT-25-A, see Paragraph 22 for instructions on replacing 2. Shorted turns in oscillator coil. Replace coil set 3. Open circuit 102 resistor 4. Open circuit 105 resistor NOTE: It has been found that when a transmitter is stored without motion or vibration for a long period of time, microscopic particles may collect between the stationary plates of the oscillator tuning capacitors 116, 117, 120, which increase the leakage enough to prevent oscillation. An effective remedy for this is to remove the transmitter cabinet and blow out the plates of the variable air capacitors with a current of clean, dry air. This is done if the symptons listed above have been encountered, and no fault can be found in the tubes or the circuits. If an ordinary shop air-hose is used the air should first be tested by blowing it through a fine cloth, to make sure it does not contain dust. Select a clean, dust free location for this blowing-out process, and do not allow the transmitter chassis to stand around, or be stored outside of its cabinet
C. No sidetone	CW and TONE position	1. Check the two Tube VT-52; replace if necessary 2. Check capacitor 106 for open or short 3. Capacitor 107 open or shorted 4. Check continuity of 125 primary
D. No sidetone	VOICE POSITION	1. Check the two Tube VT-52; replace if necessary 2. Check 101 for open 3. Shorted 111 4. Open Primary 123
E. No modulation	TONE and VOICE position	1. Defective Tube VT-52 2. Open Primary 124 3. Open Secondary 125 4. Open Secondary 123

RADIO TRANSMITTER BC-AS-230 ALIGNMENT AND NEUTRALIZATION

Equipment required:

1. Frequency meter SCR-211J or equivalent.
2. 200 MA meter and plug suitable for jack 128.
3. Oscilloscope.

Adjusting Radio Transmitter BC-AS-230 for operation (bench procedure):

Install coil set covering frequency desired.

Insert open circuit plug in r-f amplifier jack 128.

Connect dummy antenna A-55.

Turn on equipment, warm up for three or four minutes.

Turn on frequency meter and tune to desired frequency, couple loosely to oscillator, by bringing antenna close to oscillator tube.

Turn oscillator dial to desired frequency. Dial setting given on coil set.

Press key on Radio Control Box BC-AT-232.

Turn oscillator dial until zero beat is heard in frequency meter phone line. This should occur within thirty vernier dial divisions of the original calibration; if greater, change oscillator tube and repeat the above procedure.

Return oscillator dial to original calibration point and adjust oscillator trimmer 120 for zero beat in headphones of frequency meter. If adjustment is beyond range of oscillator trimmer 120, cover should be removed, 120 turned to midpoint. Zero-beat is then obtained by adjusting condenser 117 (loosen lock nut on rotor).

Return transmitter to cabinet and readjust capacitor 120 for zero-beat.

Neutralize final amplifier:

Connect oscilloscope across dummy load A-55, antenna post to ground.

Tune r-f amplifier and dummy load for maximum indication on scope. If no indication is obtained, the circuit is already neutralized or amplifier stage is not operating.

Adjust neutralizing capacitor 119 for minimum deflection on oscilloscope. If adjustment is broad (no deflection for large rotation of capacitor 119) set capacitor midway between points where deflection is obtained.

Open key on Radio Control Box BC-AT-232 and connect 200 MA meter in place of open circuit plug in r-f amplifier jack 128.

Close key at Radio Control Box BC-AT-232 and tune amplifier for minimum plate current. Antenna loading tap 130 near minimum.

Increase antenna loading 130 (use more turns of coil) by small degrees retuning r-f amplifier after each increase.

Loading should be increased until there is no increase in antenna current or until r-f plate current is 34 ma. **Do not load r-f amplifier beyond 34 ma as indicated with meter plug in jack 128.**

24. USE OF TEST SET I-56-A FOR MAINTENANCE OPERATION OF RADIO SET SCR-AS-183

Test Set I-56-A includes the following instruments:

Radio Set Selector Analyzer (Model 665, type 2) with Socket Selector. Unit (Model 666, type 1B) and Capacity Unit (Model 666, type 2).

Voltohmmeter (Model 564, type 3B).

Output Meter (Model 571, type 3A).

Tube Tester (Model 685, type 2).

The following types and methods of measurement can be made with these instruments to carry out the trouble-hunting and maintenance operations outlined in the preceding sections. For detailed instructions on the use of the controls of these instruments after connections to Radio Set SCR-AS-183 are made as described below, see *Instruction Book for Test Set I-56-A.*

a. Transmitter Tube Currents (see Table I)

For measurement of the amplifier and modulator-oscillator plate currents in Radio Transmitter BC-AS-230 only an external d-c milliammeter is required. Plug a two-wire cord, on Plug PL-55 or equivalent, into jack 127 for the modulator-os-

cillator current, and into jack 128 for the amplifier current. Connect the free ends of the cord into the M. A. pin-jacks at the right-hand side of Model 665 Analyzer, using the "—" and 250 pin-jacks for modulator-oscillator current and the "—" and 50 pin-jacks for amplifier current. The Socket Selector block and cord are not used. Follow the instructions given on page 26 of this book with regard to operating the transmitter, at resonance, into a suitable artificial antenna; otherwise the plate-current indications will be meaningless. (Antenna currents are measured on the thermal ammeter of the transmitter.)

b. Junction Box Voltages (see Table II)

Measure all junction box voltages by contacting the terminals with probe cords, the pin ends of which are inserted either in the proper V terminals of the Model 564 Voltohmmeter, or in the proper Volts pin-jacks at the left-hand side of the Model 665 Analyzer. The socket selector block and cord are not used.

c. Transmitter Plate and Bias Voltages (see Table III)

The radio oscillator grid bias cannot be measured by means of Test Set I-56-A. The amplifier-modulator grid bias cannot be measured with the transmitter in its case because of the large series-grid resistor 100. Do not try to use Model 666 Socket Selector in the transmitter for voltage measurements with the power on. This procedure is unsafe and may give misleading results. Remove the transmitter case, mount the transmitter coil set in place and retune the transmitter. Keep the antenna circuit in resonance. Use a high-resistance d-c voltmeter, i. e., the appropriate scales of either Model 665 analyzer of Model 564 Voltohmmeter. For the amplifier-modulator grid bias connect the voltmeter across the terminals of resistor 104 (see Figure 18) or capacitor 113. The radio-oscillator plate voltage is between the ungrounded terminal capacitor 112 and ground. The values of amplifier and modulator plate voltage given in the table are obtained respectively at terminal 20 of the transmitter power receptacle and 4 of tone-oscillator coil 125. Be sure that the transmitter is operating normally with the antenna circuit tuned for maximum current on the antenna ammeter while these measurements are made.

d. Receiver Plate, Screen and Bias Voltages (see Table IV)

It is not necessary to measure directly the plate and screen currents of the tubes in the receiver, in looking for circuit faults. The values of control-grid bias on all tubes are a measure of normal plate and screen-grid currents since all the tubes except the diode detector are auto-biased. The bias voltages given in Table IV may be measured by means of Model 666 Socket Selector, provided that the control grids of all the tubes, Tube VT-49, not in the Socket Selector are short-circuited to ground to prevent self-oscillation of the amplifier. This Socket Selector consists of a plug with suitable adapters for plugging into any tube socket in place of the tube, the plug being connected through a cord to an external socket block which, together with its adapters, forms a universal tube socket block which, together with its adapters, forms a universal tube socket with exposed pin-jack terminals at each tube electrode from which flexible jumper-cords can be run to the desired terminals on Set Analyzer. With the controls set as specified in Table IV the voltages on Tube VT-38 and Tube VT-49 sockets are measured as follows: mount 5-prong adapters on Model 666 Socket Selector block and cord and remove the tube from the receiver socket in question; mount the tube in Socket Selector block and plug the cord into the receiver socket; connect the appropriate d-c scale of the Analyzer voltmeter between ground and socket-terminals 1 or 5 for the heater voltage, 2 for the plate voltage, 3 for the screen-grid voltage and 4 for the control-grid bias. The procedure for the socket for Tube VT-37 is similar except that the only significant voltage is the heater voltage since the other electrodes are not biased. For convenience in checking, all values in the table are recorded as voltage to ground and the negative terminal of the voltmeter may therefore be grounded on any part of the receiver. The heaters of the tubes are wired in series-parallel so that these positive terminals are alternately 6 and 12 volts to ground.

e. Vacuum Tube Tests

The tests described in the foregoing paragraphs are not tests of the vacuum tubes, but of the circuits and circuit constants, so it is important that the tubes themselves all have normal volt-ampere characteristics of the various types of tubes may be made with the Model 685 Tube Tester. For the tubes alone follow the instructions given in *Instruction Book for Test Set I-56-A.*

f. Continuity Tests

Many of the continuity tests suggested in Paragraph 23 of this book involve circuits ending at tube sockets, and can therefore be made on both transmitter and receiver with Model 665 Analyzer (ohmmeter terminals) in connection with Model 666 Socket Selector. All power must be off the equipment when continuity tests are made. Where a circuit must be checked which does not terminate in either a tube socket or a power receptacle the case must be removed from the unit, and a probe cord used to connect the ohmmeter to the hidden terminal. On page 6 of the *Instruction Book for Test Set I-56-A* instructions are given for the measurement of capacities with Model 665 Set Analyzer and Model 666 Capacity Unit. The paper dielectric by-pass capacitors 1, 2, 3, 4, 5, 6, 7, 8, 78, 107, 109, 112, 113, 147, etc., of Radio Set SCR-AS-183 may be checked by this method, but not the various mica capacitors, because the capacities of the latter are too small to be indicated by the instrument.

25. USE OF VOLTAGE AND CURRENT TABLES

The tables which follow give different values of current and voltage in various points in the circuit of Radio Set SCR-AS-183. These tables are useful in checking the performance of the equipment suspected of faulty operation. All voltage readings are made with a high resistance voltmeter.

Table I shows typical values of current measured at jacks 127 and 128 in the radio transmitter. For measurements of these currents an external DC milliammeter of 100 or 150 milliamperes full scale is required. This instrument and its connecting cord and plug must be insulated for full plate voltage of the equipment. See SAFETY NOTICE.

Table II lists the d-c voltages which can be measured at the indicated terminals in junction box or at the same numbered terminals on the other units connected to Junction box.

Table III indicates the normal plate and bias voltages at the tube sockets in the radio transmitter. Table IV lists the voltages at the tube sockets in the radio receiver.

TABLE I

Frequency kc	* *Antenna Coil Tap*	*Modulator Oscillator Plate Current*		*Amplifier Plate Current*		*Antenna Current*	
		12 Volts	*14 Volts*	*12 Volts*	*14 Volts*	*12 Volts*	*14 Volts*
6200	10	0.077 amp	0.088 amp	0.028 amp	0.034 amp	0.80 amp	0.95 amp
6500	9	0.077	0.088	0.028	0.034	0.81	0.96
6800	9	0.077	0.088	0.028	0.034	0.83	0.98
7100	8	0.078	0.090	0.028	0.034	0.83	0.98
7400	8	0.083	0.098	0.028	0.034	0.83	0.98
7700	7	0.089	0.105	0.027	0.032	0.80	0.92

* The figures in this column represent the number of turns on the coil between tap 130 and the base of the coil, setting this tap in each case for the best combination of radio output and modulation. At every point a somewhat higher tap would give slightly greater power output, but at the expense of greater amplifier plate current and less modulation. The antenna coil tap should never be left at a point at which the amplifier plate current exceeds 36 milliamperes on 14 volts or about 30 milliamperes on 12 volts. On the other hand, the transmitter should not be so tuned that the modulator-oscillator current exceeds 120 milliamperes at 14 volts or 105 milliamperes at 12 volts.

TABLE II—TYPICAL JUNCTION BOX VOLTAGES

CONTROLS AT MANUAL, VOICE, TRANSMIT

Voltages to Ground 12 Volts Supply	*Voltages to Ground 14 Volts Supply*	*Terminals*
11.5	13	34, 35, 38, 45, 63, 94
12	14	25, 44, 91
265	305	20, 22, 41, 42
285	325	21, 26, 29, 40
300	340	31,57

2-7 volts on 33 and 51, depending upon the resistance of the microphone. (Zero voltage on all other terminals)

CONTROLS AT MANUAL, VOICE, RECEIVE

Voltage to Ground 12 Volts Supply	*Voltage to Ground 14 Volts Supply*	*Terminals*
11.6	13.2	33, 34, 35, 38, 45, 48, 51, 63, 65, 67, 94
12	14	25, 44, 91
216	250	39, 56
310	355	26, 29, 30
260	300	31, 57
	Zero voltages on other terminals	

..NOTE: All the voltages listed above will vary somewhat with lengths of cords, ages of tubes, and condition of circuit resistors. Check the tubes independently and measure circuit resistance and continuity.

TABLE III—TYPICAL PLATE AND BIAS VOLTAGES IN RADIO TRANSMITTER BC-AS-230

CONTROLS AT MANUAL, VOICE, TRANSMIT

Tube	*Grid Bias to Ground*		*Plate Voltage to Ground*	
	12 Volts	*14 Volts*	*12 Volts*	*14 Volts*
Radio Oscillator (VT-25-A)			180	210
Modulators (VT-52)	45	55	265	310
Radio Amplifier (VT-25-A)	45	55	260	305

TOTAL INPUT TO EQUIPMENT

Supply Voltage	*(Transmit Voice) Supply Current*	*(Receiver Only) Supply Current*
12	7.5 amp	4.8 amp
14	8.5	5.2

TABLE IV—TYPICAL PLATE, SCREEN AND BIAS VOLTAGES IN RADIO RECEIVER BC-AS-229

CONTROLS AT MANUAL, RECEIVE

Control grids short-circuited to ground. Volume control at maximum. All bias voltages measured with respect to ground.

Tube	*Heater Volts*		*Screen Grid Volts*		*Plate Volts*		*Control Grid Bias (Cathode to Ground) Volts*	
	12	*14*	*12*	*14*	*12*	*14*	*12*	*14*
First Tube VT-49	5.9	6.8	105	121	220	255	5.4	6.5
Second Tube VT-49	11.8	13.6	105	121	218	250	5.4	6.5
Third Tube VT-49	11.8	13.6	105	121	216	248	5.0	6.2
Fourth Tube VT-49	5.9	6.8	210	245	214	245	15.0	18.0
Tube VT-37	5.9	6.8						
Tube VT-38	11.8	13.6	210	245	230	260	21.0	24.0

NOTE: All voltages listed above will vary somewhat with lengths of cord, age, of tubes, and condition of circuit resistors. Check the tubes independently and measure circuit and resistance and continuity.

SECTION V
SUPPLEMENTARY DATA

26. TABLE OF REPLACEABLE PARTS

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		RADIO RECEIVER BC-AS-229			
1a	2C4229/1 (3DA100-5 may be substituted)	Capacitor; 0.1 mfd, paper, working voltage 400 v d-c, assembled with 2a	Screen grid by-pass	CD 9LS-52050	306-1064
1b	2C4229/1	Same as 1a, assembled with 2b	Screen grid by-pass	CD 9LS-52050	306-1064
1c	2C4229/1	Same as 1a, assembled with 2c	Screen grid by-pass	CD 9LS-52050	306-1064
2a	2C4229/1	Same as 1a, assembled with 1a	Plate by-pass	CD 9LS-52050	306-1064
2b	2C4229/1	Same as 1a, assembled with 1b	Plate by-pass	CD 9LS-52050	306-1064
2c	2C4229/1	Same as 1a, assembled with 1c	Plate by-pass	CD 9LS-52050	306-1064
3a	2C4229/3 (3DA100-6 may be substituted)	0.1 mfd, paper, working voltage 400 v d-c, assembled with 4a	Cathode by-pass	CD 5WS	306-1065
3b	2C4229/3	Same as 3a, assembled with 5b	Cathode by-pass	CD 5WS	306-1065
3c	2C4229/3	Same as 3a, assembled with 4b	Cathode by-pass	CD 5WS	306-1065
4a	2C4229/3	Same as 3a, assembled with 3a	Filter	CD 5WS	306-1065
4b	2C4229/3	Same as 3a, assembled with 3c	Filter	CD 5WS	306-1065
5a	2C4229/3	Same as 3a	Heater by-pass	CD 5WS	306-1065
5b	2C4229/3	Same as 3a, assembled with 3b	Heater by-pass	CD 5WS	306-1065
6	2C4229/6 (3DA500-10 may be substituted)	Capacitor; 0.5 mfd, working voltage 300 v d-c, paper	Audio cathode by-pass (in parallel with capacitor 8a and 8b)	CD 5WLS SS P9013	306-1070
7	2C4229/6	Same as 6	Plate by-pass	CD 3WLS SS P9013	306-1070
8a	3DA500-15	Capacitor; 0.5 mfd. working voltage 300 v d-c, paper	Audio cathode by-pass (in parallel with 8b and 6)	CD PC-2037	306-1071
8b	3DA500-15	Part of 8a and same as 8a	Audio cathode by-pass (in parallel with 8b and 6)	CD PC-2037	306-1071
9a		Capacitor; 0.004 mfd, ±10%, mica	Output filter	AC 1461	306-1072
9b	3DA4-2	Same as 9a	Output filter	AC 1461	306-1072

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		RADIO RECEIVER BC-AS-229—Continued			
9c		Same as 9a	Output filter	AC 1461	306-1072
11		Capacitor; 0.006 mfd, ±5%, mica	Coupling	AC 1461	306-1068
12		Capacitor; 0.0001 mfd, ±5%, wax dip	Filter	AC 1465	306-1069
58a	2C4229.3/58	Capacitor gang; variable, air	Amplifier tuning	RC 80065	361-1026
58b	2C4229.3/58	Same as 58a	Amplifier tuning	RC 80065	361-1026
58c	2C4229.3/58	Same as 58a	Amplifier tuning	RC 80065	361-1026
58d	2C4229.3/58	Same as 58a	Amplifier tuning	RC 80065	361-1026
59b		Capacitors; fixed air, assembled with item 58	Amplifier aligning		
59c		Same as 59b	Amplifier aligning		
59d		Same as 59b	Amplifier aligning		
61a	3Z6020-2	Resistor; 200 ohms ±5%, carbon, insulated, 1/3 watt, pigtail terminals	Decoupling	AB Type E	363-1052
61b	3Z6020-2	Same as 61a	Decoupling	AB Type E	363-1052
61c	3Z6020-2	Same as 61a	Decoupling	AB Type E	363-1052
61d	3Z6020-2	Same as 61a	Decoupling	AB Type E	363-1052
61e	3Z6020-2	Same as 61a	Decoupling	AB Type E	363-1052
61f	3Z6020-2	Same as 61a	Decoupling	AB Type E	363-1052
61g	3Z6020-2	Same as 61a	Decoupling	AB Type E	363-1052
67	3Z6802	Resistor; 2 megohms, ±10%, ceramic, lead tinned copper	Grid resistor	IRC F-1/3	363-1068
68	3Z6750-1	Resistor; 500,000 ohms, ±5%, 1/3 watt, carbon, insulated, pigtail terminals	Plate resistor	AB Type E	363-1065
69		Resistor; 2 megohms, ±10%, 1/3 watt, carbon, insulated, pigtail terminals	A.G.C. filter resistor	AB Type E	363-1066
70		Same as 69	Grid resistor	AB Type E	363-1066
71	2C4229/71	Output transformer; step-down, 2.9/1 ratio	Output coupling	MW 1-291	362-7012
72		Resistor; 100,000 ohms, ±5%, ½ watt, carbon, insulated, pigtail terminals	Isolating resistor	AB Type E (EB)	363-1061

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		RADIO RECEIVER BC-AS-229—Continued			
73	3Z6200-3	Resistors; 2000 ohms, ±5%, 1/3 watt, carbon, insulated, pigtail terminals	Bias resistor	AB Type E	363-1064
78	2C4229.1	Same as 1a	Plate by-pass	CD 9LS-52050	306-1064
79		Capacitor; 9 mmfd, mica	Compensating capacitor, coil panel assembly 281	U	
80	2C4229.3/80	Capacitor; variable capacity 20-150 mmfd	Input alignment	T 18-F-116	368-1409
84	2C6230/84A	Antenna binding post assembly	Antenna connection	SM A-10,010A	465-2006
86	2C6230/86A	Ground binding post assembly	Ground connection	SM A-10,000A	465-2007
87	2Z5893	Neon bulb	Overload preventer	GE WE-FR-6-A	354-1085
88a	3Z6075-2	Resistor; 750 ohms, ±5%, carbon, insulated, 1/3 watt, pigtail terminals	Cathode by-pass	AB Type E	363-1063
88b	3Z6075-2	Same as 88a	Bias resistor	AB Type E	363-1063
94	2C4229/95	Choke; 0.41 henries ±5% at 3 volts, 900 cps, approximately 3250 turns #33 AWG enameled copper wire	Audio output filter	MW 1-290	362-7011
97		Capacitor; 120 mmf, +30% –10%, ADS disc, button type, silver mica	R-F coupling	P 306-1063 AB Type E	306-1063
98	3Z6030/3	Resistor; 300 ohms, ±5%, 1/3 watt, carbon, insulated, pigtail terminals	Bias resistor	P 363-1060 AB Type E	363-1060
99	3Z6500-5	Resistor; 5,000 ohms, ±5%, 1/3 watt, carbon, insulated, pigtail terminals	Decoupling	AB Type E	363-1062
145	3Z5470.1	Resistor; 7,000 ohms, ±2%, center tap, special finish	Voltage divider	WL 3068C	363-1067
162		Receptacle ring, part of socket SO-41	Receptacle ring for plug PL-61	AE	268-1651
163		Receptacle plate, part of socket SO-41	Receptacle plate for plug PL-61	U	368-1410
240	2Z3703	Receiver dial; 100 divisions equally spaced in 180° calibrations accurate within 0.2 degree		EC	268-1691
244	2Z5760.1	Condenser knob; part of 80	Input alignment	T 07-C-18A	267-4270
252		Shock-proof cup assembly	Support for Radio Receiver BC-AS-229	P 368-1460	368-1460

Reference No.	S. C. Stock No.	Name and Description	Function	Mfr's. Symbol and Dwg. No.	Contractor's Drawing No.
		RADIO RECEIVER BC-AS-229—Continued			
253		Shock-proof cup assembly; same as 252 except for position of stud	Support for Radio Receiver BC-AS-229	P 368-1459	368-1459
254	2Z8602	Snapslide; H.H. nickel silver		FWS	268-1555
255		Snapslide stud; H.H. brass rod	Snapslide stud for coil compartment	EC	268-1533
256		Same as 255	Snapslide stud for tube compartment	EC	268-1533
257	2C4229.3/257	Socket assembly; five-prong socket, spec. material and springs	Tube socket	U 115023	267-4235
259	2Z7059	Pin plug	Coil panel assembly 281	U	268-1949
260	2Z2724	Grid clip; .018 spring brass	Grid clip for control tube	NC 24	268-1669
261		Tuning outlet; right (part of dial gear unit, 275)	Dial gear unit 275	HAS	268-1675
262		Tuning outlet, left aluminum rod	Dial gear unit 275	HAS	268-1674
266	2C4229.3/266	External spline, right, male, steel		SAS	268-1682
267		External spline, left, male, steel		SAS	268-1683
268	2C4229.3/268	Cap nut, for tuning outlet		HAS	268-1678
271	SCD-2015-C	Snapslide stud; half hard brass rod, part of shock-proof cup assemblies 252 and 253	Snapslide stud for mounting FT-99	P 268-1757	268-1757
272	2C4229/272.1	Cover assembly	Tube cover	PI 368-1407	368-1407
273		Cabinet assembly; riveted aluminum case with one end blank and the other open	Chassis assembly	EC	368-1341
274		Front panel		EC	268-1530
275	2C4229.3/275	Dial gearing unit assembly	Tuning gear unit	P 368-1408	368-1408
276		Tube shield; part of chassis assembly	Reduces capacity coupling between tuned stages	AH	268-1660

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		RADIO RECEIVER BC-AS-229—Concluded			
277		Capacitor cover; part of cabinet assembly 273, #23 (.0255) B & S gauge nickel silver, spring temper	Aligning capacitor cover	EC	268-1644
281		Coil receptacle plate assembly		U 152227	368-1411
284	2C4179/118	Mounting bracket assembly		AE	368-1397
361	2Z2500-401	Chart MC-401	Frequency calibration	EC	268-1659
	2Z6649	Mounting FT-99		ST	368-1394
		Tube VT-38, commercial type 38	Audio amplifier		354-1082
		Tube VT-37, commercial type 37	Detector		354-1081
		Tube VT-49, commercial type 39/44	Radio amplifier		354-1080
		DYNAMOTOR UNIT BD-AS-83			
G3480		Pole shoe assembly		PM	G3480
G3482		Red lead assembly		PM	G3482
G3483		Black-white lead assembly		PM	G3483
G3484		White lead assembly		PM	G3484
G3485		Black lead assembly		PM	G3485
G3486		End bracket and brush holder assembly, L.V. end		PM	G3486
G3487		Brush holder assembly, L.V. end		PM	G3487
G3488		End bracket and brush holder assembly H.V. end		PM	G3488
G3489		Brush holder assembly, H.V. end		PM	G3489
G3491		Field coil assembly		PM	G3491
G3492		Armature assembly		PM	G3492
P3253		End bracket		PM	P3253
P3391		End bracket cover		PM	P3391
P3394		Screw		PM	P3394

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		DYNAMOTOR UNIT BD-AS-83—Concluded			
P3401		Ball bearing		PM	P3401
P3436		Brush holder lug		PM	P3436
P3437		Bearing retainer		PM	P3437
P3439		Oil slinger		PM	P3439
P3442		Screw		PM	P3442
P3516		Washer		PM	P3516
P3596		Screw		PM	P3596
P3678		Screw		PM	P3678
P3679E		Brush, L.V.		PM	P3679E
P3679E		Spare brush (two)		PM	P3679E
P3680E		Brush, L.V. (–)		PM	P3680E
P3680E		Spare brush (two)		PM	P3680E
P3690		End bracket		PM	P3690
P3787		Wire cover		PM	P3787
P3807		Washer		PM	P3807
P4715		Set screw		PM	P4715
P4837		Nut		PM	P4837
P5009		Brush cap		PM	P5009
P5031		Stud		PM	P5031
P5032		Shell		PM	P5032
P5102		Brush H.V. (+)		PM	P5102
P5103		Brush H.V. (–)		PM	P5103
P5115		Name plate		PM	P5115
P3441-A		Brush spring L.V.		PM	P3441-A
P3438-C		Brush spring H.V.		PM	P3438-C

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*		*Contractor's Drawing No.*
		RADIO TRANSMITTER BC-AS-230				
	2Z6650	Mounting Ft-100		ST		368-1395
84	2C6230/84A	Antenna binding post	Antenna connection	SM	A-.0,010A	465-2006
86	2C6230/86A	Ground binding post	Ground connection	SM	A-10,000A	465-2007
100	3Z6700-7	Resistor, 100,000 ohms, ±5%, ½ watt, carbon, insulated, pigtail terminals	Isolating resistor	AB	Type EB	363-1054
101	3Z6010-8	Resistor, 100 ohms, ±5%, ½ watt, carbon, insulated, pigtail terminals	Voltage dropping resistor	AB	Type EB	363-1055
102	3Z6570	Resistor, 7,000 ohms, ±2%, 15 watts minimum, porcelain, lug terminals	Voltage dropping resistor	AB WL	Type GB 3067C	363-1058
103	3Z6610-2	Resistor; 10,000 ohms, ±2%, 15 watts minimum, porcelain, lug terminals	Load resistor	AB WL	Type GB 3067C	363-1059
104	3Z6620-5 or -1	Resistor; 20,000 ohms, ±5%, 1 watt, pigtail terminals, carbon, insulated	Bias resistor	AB	Type EB	363-1053
105		Resistor; 30,000 ohms, ±5%, 1/3 watt, carbon, insulated, pigtail terminals	Grid resistor	IRC AB	BWI Type EB	363-1057
106		Capacitor; 0.006 mfd, ±5%, mica	Grid coupling for tone oscillator	AC	1461	306-1068
107	2C4229/3	Capacitor; 0.1 mfd., working voltage 400 v d-c, paper	Tone oscillator capacitor	CD	5WS	306-1065
109	2C4229/3	Same as 107 with 107 forms two-section unit	Audio by-pass capacitor	CD	5WS	306-1065
110a		Same as 106	R.F. by-pass	AC	1461	306-1068
110b		Same as 106	R.F. by-pass	AC	1461	306-1068
111	2C4229/8	Capacitor; 20 to 35 mfd. (rated 25 mfd.), rated voltage 25 v d-c, electrolytic	Audio filter	CD	MA-12043-3	306-1067
112	2C4229/1	Capacitor; 0.1 mfd., working voltage 400 v d-c, paper	R.F. by-pass	CD	9LS52050	306-1064
113	2C4229/1	Same as 112	Voltage, stabilizer	CD	9LS52050	306-1064
114		Capacitor; 120 mmfd., +30% -10%, ADS. disc button type, silver mica	Grid coupling for master oscillator	ER	370Dwg. 613-000	306-1063
115	3Z6801-2	Resistor; 1 megohm, ±5%, ½ watt, carbon, insulated, pigtail terminals	Shunt resistor	AB	Type EB	363-1056

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		RADIO TRANSMITTER BC-AS-230—Continued			
116	2C6230.3/116	Capacitor; variable, air, assembled with 117,120	Radio oscillator main tuning	RC RC80066	361-1024
117	2C6230.3/116	Capacitor; fixed, air assembled with 116, 120	Radio oscillator padder	RC RC80066	361-1024
118	2C6230.3/118	Capacitor; variable, air	Antenna tuning	RC RC80067	361-1023
119	2C6230/119	Capacitor; leaf, mica, variable balancing	Neutralizing capacitor	T 18F117	361-1025
120		Capacitor; air assembled with 116,117	Compensating capacitor		
123	2C6230/123	Transformer; step-up, 40/1 ratio	Microphone transformer	MW 1-288	362-7009
124	2C6230.3/124	Transformer; step-up, 3/1 ratio	Modulation transformer	MW 1-289	362-7010
125	2C6230/125	Coil assembly, 2/1 ratio, two windings; inductance for inner winding, .240 henries max., .230 henries minimum at 3 volts, 900 cps, d-c resistance at 68° F for inner winding 183 ohms, for outer winding 125 ohms	Tone oscillator transformer	MW 1-287	362-7008
127	2C6200/127	Jack; modulator-oscillator plate current jack assembled with 128	Master oscillator and modulator current	T	368-1402
128	2C6200/127	Jack; same as 127 assembled with 127	R.F. amplifier plate current	T	368-1402
129	2C6230/129	Ammeter; 0-1.5 amps.	Indicates antenna current	WE Model 507	461-1005
168		Receptacle ring for plug PL-64	Part of socket SO-44	AE	268-1651
169		Receptacle plate for plug PL-64	Part of socket SO-44	U	368-1403
170		Capacitor; 3 mmfd., ±0.25 mmfd., fixed; balancing body 7/16″ long x 7/32″ dia., 1½ leads, 3-7/16″ overall	Parallel neutralizing	E P120K	306-1066
241		Frequency control knob 1.00 equal divisions, numbered every tenth division	Adjust frequency control	PB	268-1655
242	2Z3700	Frequency control dial	Calibration	EC	268-1656
243	2Z5767.1	Antenna capacitor knob and shaft assy. Knob molded on shaft. .188″ dia. shaft x 1.125″ from base of knob. Knurled grip of knob ⅝″ dia. Knob ⅜″ high. Knob lettered ANTENNA TUNING	Antenna tuning	BB	368-1405
250	2C6230/250.1	Lock screw knob	Lock for frequency control	FP	268-1647
251	2C6230/250	Lock screw knob	Lock for antenna capacitor	SAS	268-1646

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		RADIO TRANSMITTER BC-AS-230—Continued			
252		Shock-proof cup assembly	For FT-100	P 368-1460	368-1460
253	2Z6649/10	Same as 252 except for position of stud	For FT-100	P 368-1459	368-1459
254	2Z8602	Snapslide H.H. nickel silver	Mounting bracket assembly 284	FWS	268-1555
255		Snapslide stud; brass rod	Lock for coil compartment, cabinet assembly 273	EC	268-1533
256		Same as 255	Lock for tube compartment, cabinet assembly 273	EC	268-1533
258	2C6230.3/258	Socket assembly; four-prong socket		U	267-4224
259	2Z7059	Pin plug	Coil panel assembly 282	U	268-1949
271		Snapslide stud; half hard brass rod for FT-100	Shock-proof cup assemblies 252 and 253	ST	268-1757
278		Cabinet assembly		EC	368-1341
279		Front panel	Chassis assembly	EC	268-1540
280	2C6230/280	Cover assembly	Tube cover assembly	PI	368-1398
282		Coil panel assembly	Coil panel assembly	U 152229	368-1401
283		Capacitor cover	Cover for parallel neutralizing capacitor, chassis assembly	EC	268-1644
284	2C4179/118	Mounting bracket assembly		AE	368-1397
288		Same as 283	Cover for compensating capacitor, cabinet assembly 278	EC	268-1644
289		Compensating capacitor control shaft; cold roller steel	Oscillator capacitor assemblies 116, 117, 120	RC	268-1747
290		Supporting ring assembly		AE	368-1404
		Tube VT-25-A, commercial type 10 special	Radio amplifier		354-1084
		Tube VT-52, commercial type 45	Modulator		354-1083

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		RADIO CONTROL BOX BC-AS-231 (RECEIVING)			
		Radio Control Box BC-AS-231	Radio Control Box for Radio Receiver BC-AS-229	P 368-1508	368-1508
	2Z6668	Mounting FT-118 52, SH aluminum #11 (.091) B & S gauge	Mounting for Radio Control Box BC-AS-231	ST	368-1382
60	3Z6020-2	Resistor; 200 ohms, ±5%, 1/3 watt, carbon, insulated, pigtail terminals	Bias resistor	AB Type E	363-1052
131	2C3231.3/131	Resistor; variable, 0-40,000 ohms, +30% –0%, hop-off 90 ohms	Manual sensitivity control resistor	SR	363-5002
132	2C3231.3/131	Resistor; variable, 0-30,000 ohms, +30% –0%, hop-off 12 ohms	A.G.C. level adjusting resistor	SR	363-5002
133	2C3231/133	Jack assembly	Jack for double headset	T	368-1386
134	2C3231.3/134	Switch assembly; switch and lever assembly	Rotary switch	OM SM D9510	462-1014
135		Base assembly	Base assembly for Radio Control Box BC-AS-231	ST	368-1381
136	2C3201.2/136	Spring	Switch stop		
166	2Z8784	Receptacle ring	For plug PL-104 (part of socket SO-84)	AE	268-1631
167	2Z8784	Receptacle plate assembly	For plug PL-104 (part of socket CO-84)	U	368-1385
254	2Z8602	Snapslide; H.H. nickel silver	Base assembly 135	FWS	268-1555
259	2Z7059	Pin plug	Receptacle plate assembly 167	U	268-1949
263	2C3181/329	Switch handle-lever; die casting alloy	Rotary switch assembly 134		268-1888
265	2C3181/331	Volume control knob		PR	268-1694
365	2Z8630	Snapslide stud; H.H. brass	Mounting assembly FT-118	ST	268-1845

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		RADIO CONTROL BOX BC-AT-232 (TRANSMITTER)			
		Radio Control Box BC-AT-232	Radio control box for Radio Transmitter BC-AS-230	P 368-1509	368-1509
	2Z6668	Mounting FT-118 52, S.H. aluminum #11 (.091) B & S gauge	Mounting for Radio Control Box BC-AT-232	ST	368-1382
135		Base assembly	Base assembly for Radio Control Box BC-AT-232	ST	368-1381
138	2C3232/140	Dual jack assy.	Microphone jack	T	368-1392
139	2C3182/131	Key assembly	Telegraph key assembly		
140		Jack	Key jack assembled with 138		
141	2C3232/141	Switch assembly (switch and lever assy.)	Rotary switch	OM SM D9510	462-1015
142	2C3182/135	Screw	Key adjusting	FP	268-1638
170		Receptacle ring	For plug PL-63 part of socket SO-43	AE	268-1625
171		Receptacle plate blk. bakelite grade xx	For plug PL-63 part of socket SO-43	U	368-1389
254	2Z8602	Snapslide, H.H. nickel silver	Base assembly	FWS	268-1555
259	2Z7059	Pin plug	Receptacle plate assembly 171	U	268-1949
263	2C3181/329	Switch handle; die casting alloy	Part of rotary switch assembly 141		268-1888
365	2Z8630	Snapslide stud, H.H. brass	Mounting assembly FT-118	ST	268-1845
		COIL SET C-436 (RECEIVING)			
		Coil Set C-436 (2,500-4,700 kc.)		P 368-1505	368-1505
13	3D9100-13	Capacitor; 0.0001 mfd, ±5%, working voltage 500 v d-c, bakelite	Coupling	CD 5	306-1059
66		Resistor; 30,000 ohms, ±5%, 1/3 watt, carbon	Grid resistor	CC K7	363-1048

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		COIL SET C-436 (RECEIVING)—Concluded			
89	2Z6615-5	Coil assembly	R-F input coil	P 368-1369	368-1369
90a		Same as 89	Tuned coupling	P 368-1369	368-1369
90b		Same as 89	Tuned coupling	P 368-1369	368-1369
90c		Same as 89	Tuned coupling	P 368-1369	368-1369
91a		Coil assembly	Tuned coupling	P 362-1053	362-1053
92		Coil assembly	Band-pass	P 368-1370	368-1370
93a		Coil; 154 turns #34 enameled copper wire	Part of band-pass coil assembly	P 362-7019	362-7019
95a		Coil; part of 91a	Input coil, part of tuned input coil assembly	P 362-1053	362-1053
254	2Z80602	Snapslide; H.H. nickel silver	Coil cover assembly	FWS	268-1555
		COIL SET C-437 (RECEIVING)			
	3C280-437	Coil Set C-437 (4,150-7,850 kc.)		P 368-1517	368-1517
13	3D9250-5	Capaciter; 0.00025 mfd, ±5%, working voltage, 500 v d-c, bakelite	Coupling	CD 5	306-1060
66	3Z6615-5	Resistor; 15,000 ohms, ±5%, ¼ watt, carbon	Grid resistor	CC K7	363-1049
89		Coil assembly	Tuned input coil	P 368-1439	368-1439
90a		Same as 89	Tuned coupling coil	P 368-1439	368-1439
90b		Same as 89	Tuned coupling coil	P 368-1439	368-1439
90c		Same as 89	Tuned coupling coil	P 368-1439	368-1439
91a		Coupling coil; tuned, coil form XM262 bakelite, L_1 approximately 15¾ turns #36 double silk enameled wire. L_2 approximately 15-5/6 turns #18 enameled wire	Coupling coil assembly	P 362-1054	362-1054
92		Coil assembly; untuned	Band pass	P 368-1440	368-1440
93a		Coil assembly	Band pass	P 368-1548	368-1548
95a		Coil assembly, same as 91a	Input tuning	P 362-1054	362-1054
254	2Z8602	Snapslide; H.H. nickel silver	Coil cover assembly	FWS	268-1555

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		COIL UNIT C-439 (RECEIVING)			
	3C280-439	Coil Unit C-439 (201-398 and 2,500-4,700 kc.)		P 368-1516	368-1516
13		Capacitor; 0.0001 mfd., ±5%, working voltage 500 v d-c, bakelite	Coupling	CD 5	306-1059
66	3Z6615-5	Resistor; 15,000 ohms, ±5%, ¼ watt, carbon	Grid resistor	CC K7	363-1049
82	3D9250-5	Capacitor; 0.00025 mfd., ±5%, working voltage 500 v d-c, bakelite	Voltage divider	CD 5	306-1060
89		Coil assembly, tuned input	Input tuning	P 368-1451	368-1451
90a		Same as 89	Tuned coupling assembly	P 368-1451	368-1451
90b		Same as 89	Tuned coupling assembly	P 368-1451	368-1451
90c		Same as 89	Tuned coupling assembly	P 368-1451	368-1451
91a		Coil assembly, high	Tuned coupling	P 368-1487	368-1487
91b		Coil assembly, low L_1, 0.80 millihenries, ±2%, L_2 2.135 mh., ±1%, wound with single silk enameled wire	Tuned coupling	P 368-7018	368-7018
92		Coil assembly, untuned	Band pass coil assembly	P 368-1452	368-1452
93a		Coil assembly, high. 107 turns #36 enameled wire	Band pass coil	P 362-1068	362-1068
93b		Coil assembly, low. #36 single silk enameled wire, 6.8 millihenries, ±2%	Band pass coil	P 362-1066	362-1066
95a		Coil assembly, high, same as 91a	Input tuning	P 368-1487	368-1487
95b		Coil assembly, low, same as 91b	Input tuning	P 362-7018	362-7018
254		Snapslide, H.H. nickel silver	Coil cover assembly	FWS	268-1555
286	3C155A/2	Switch shaft		P 368-1485	368-1485
287	3C155A/3	Switch shaft outlet, HIGH, LOW and FREQ. etched on plate	Coupling box assembly	EC	268-1593
		COIL UNIT C-440 (RECEIVING)			
	3C280-440	Coil Unit C-440 (201-398 and 4,150-7,700 kc)		P 368-1502	368-1502
13	3D9250-5	Capacitor; 0.00025 mfd, ±5%, working voltage 500 v d-c, bakelite	Coupling capacitor	CD 5	306-1060

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		COIL UNIT C-440 (RECEIVING)—Continued			
66		Resistor; 30,000 ohms, ±5%, 1/3 watt, carbon	Grid resistor	CC K7	363-1048
82		Capacitor; 0.0005 mfd, ±5%, working voltage 500 v d-c bakelite	Voltage divider	CD 5	306-1037
89		Coil assembly	Tuned input coil assembly	P 368-1373	368-1373
90a		Same as 89	Tuned coupling coil assembly	P 368-1373	368-1373
90b		Same as 89	Tuned coupling coil assembly	P 368-1373	368-1373
90c		Same as 89	Tuned coupling coil assembly	P 368-1373	368-1373
91a		Coil assembly; high, coil form XM262 bakelite, L_1 approximately 13¾ turns #36 double silk enameled wire. L_2 approximately 15 turns #18 enameled wire	Tuned coupling coil	P 368-1556	368-1556
91b		Coil assembly; low, L_1 0.80 millihenries, ±2%. L_2 2.135 millihenries, ±1%, wound with single silk enameled wire	Tuned coupling coil	P 362-7018	362-7018
92		Coil assembly	Band-pass	P 368-1374	368-1374
93a		Coil assembly; high	Band-pass coil	P 362-1074	362-1074
93b		Coil assembly; low	Band-pass coil	P 362-1075	362-1075
95a		Coil assembly; high, same as 91a	Input tuning	P 368-1556	368-1556
95b		Coil assembly; low, same as 91b	Input tuning	P 362-7018	362-7018
254	2Z8602	Snapslide; H.H. nickel silver	Coil cover assembly	FWS	268-1555
286	3C155A/2	Switch shaft		P 368-1485	368-1485
287		Switch shaft outlet; HIGH, LOW, FREQ. etched on plate	Coupling box assembly	EC	268-1593

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		COIL SET C-431 (TRANSMITTING)			
		Coil Set C-431 (2,500-3,200 kc.)		FWS	368-1511
121		Coil assembly and base	Antenna coil	FWS	368-1353
122		Coil assembly and base	Radio oscillator coil	FWS	368-1354
126	3Z6005-1	Resistor; 50 ohms, ±5%, 1/3 watt, carbon, insulated pigtail terminals	Coil resistor	AB Type E	363-1045
130		Antenna Tap	Antenna Tap	FWS	368-1345
254	2Z8602	Snapslide, H.H. nickel silver	Cover and shield assembly	FWS	268-1555
		COIL SET C-432 (TRANSMITTING)			
		Coil set C-432 (3,200-4,000 kc.)		FWS	368-1512
121		Coil assembly and base	Antenna coil	FWS	368-1356
122		Coil assembly and base	Radio oscillator coil	FWS	368-1357
126		Resistor, 100 ohms, ±5%, carbon, insulated, 1/3 watt, pigtail terminals	Coil resistor	AB Type E	363-1046
130		Antenna Tap	Antenna Tap	FWS	368-1345
254	2Z8602	Snapslide, H.H. nickel silver	Cover and shield assembly	FWS	268-1555
		COIL SET C-433 (TRANSMITTING)			
		Coil set C-433 (4,000-5,000 kc.)		FWS	368-1513
121		Coil assembly and base	Antenna coil	FWS	368-1359
122		Coil assembly and base	Radio oscillator coil	FWS	368-1360
126	3Z6007E2	Resistor, 75 ohms, ±5%, 1/3 watt, carbon, insulated, pigtail terminals	Coil resistor	AB Type E	363-1047
130		Antenna Tap	Antenna tap	FWS	368-1345
254	2Z8602	Snapslide, H.H. nickel silver	Cover and shield assembly	FWS	268-1555

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		COIL SET C-434 (TRANSMITTING)			
		Coil set C-434 (5,000-6,200 kc.)		FWS	368-1514
721		Coil assembly and base	Antenna coil	FWS	368-1362
122		Coil assembly and base	Radio oscillator coil		368-1363
126	3Z6007E2	Resistor, 75 ohms, ±5%, carbon, insulated, 1/3 watt, pigtail terminals	Coil resistor	AB Type E	363-1047
130		Antenna tap	Antenna tap	FWS	368-1345
254	2Z8602	Snapslide, H.H. nickel silver	Cover and shield assembly	FWS	268-1555
		COIL SET C-435 (TRANSMITTING)			
	3C280-435	Coil set C-435 (6,200-7,700 kc.)		FWS	368-1515
121		Coil assembly and base	Antenna coil	FWS	368-1365
122		Coil assembly and base	Radio oscillator coil	FWS	368-1366
126	3Z6005-1	Resistor; 50 ohms, ±5%, 1/3 watt, carbon, insulated, pigtail terminals	Coil resistor	AB Type E	363-1045
130		Antenna tap	Antenna tap	FWS	368-1345
254	2Z8602	Snapslide, H.H. nickel silver	Cover and shield assembly	FWS	268-1555
		ANTENNA SWITCHING RELAY BC-AS-198			
	2C498.1	Antenna switching relay	Antenna switching relay for Radio Set SCR-AS-183		368-1510
	2Z6668	Mounting FT-118 52, SH aluminum # 11 (.091) B & S gauge	Mounting for Antenna Switching Relay BC-AS-198	ST	368-1382
135		Base assembly	Base for Antenna Switching Relay BC-AS-198	ST	368-1381
173		Receptacle ring for plug PL-77	Part of Socket SO-57	AE	268-1631
175		Receptacle plate for plug PL-63	Part of Socket SO-57	U	368-1380
254	2Z8602	Snapslide; H.H. nickel silver	Base assembly 135	FWS	268-1555

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		ANTENNA SWITCHING RELAY BC-AS-198—Concluded			
259	2Z7059	Pin plug	Part of receptacle plate assembly	U	268-1949
285	2C498.2/5	Relay assembly	Antenna relay assembly	GE	462-1013
332	2C498/1A	Binding post	Antenna binding post	SM	465-2003
333	2C498/3A	Binding post	TR binding post	SM	465-2005
334	2C498/2A	Binding post	REC binding post	SM	465-2004
365	2Z8630	Snapslide; H.H. brass	Mounting assembly FT-118	ST	268-1845
		MISCELLANEOUS ITEMS			
152		Resistor; 1,500 ohms, ±2%, 10 watts, minimum, wire wound porcelain, special finish	Drop resistor	WL 3064B	363-1050
164		Receptacle ring for plug PL-62	Part of socket SO-42	AE	268-1625
165		Receptacle plate for plug PL-62, black, bakelite, grade xx	Part of socket SO-42	U	368-1350
246	SH5358	Sub-base M-158; plates 52-S ½ H. aluminum		ST	368-1378
254	2Z8602	Snapslide; H.H. nickel silver	Dynamotor unit assembly	FWS	268-1555
146	3Z6500-2	Resistor; 5,000 ohms, ±2%, 10 watts minimum, wire wound, porcelain, special finish	Filter resistor	WL 3065B	363-1051
147a	3H1783/47	Capacitor; 0.8 mfd, working voltage 400 v d-c, paper, forms three-section unit with 147b and 147c	Filter capacitor		306-1062
147b	3H1783/47	Same as 147a	Assembled with 147a		306-1062
147c	3H1783/47	Same as 147a	Assembled with 147a		306-1062
148	3H1783/48	Filter choke; 8 henries, minimum inductance, 10 microhenries at 100 kc.	Filter choke	MW	362-7007
149		Radio choke, minimum inductance 10 microhenries	Radio choke	P 362-1040	362-1040
		Dial MC-372 0-100 divisions, 201-398 and 2,500-4,700 kc.		EC	368-1549
360		Dial MC-390 0-100 divisions, 201-398 and 4,150-7,700 kc.		EC	368-1550

26. TABLE OF REPLACEABLE PARTS—Continued

Reference No.	*S. C. Stock No.*	*Name and Description*	*Function*	*Mfr's. Symbol and Dwg. No.*	*Contractor's Drawing No.*
		MISCELLANEOUS ITEMS—Concluded			
361		Chart MC-401	Frequency chart for Receiver BC-AS-229	EC	268-1919
	3H1783AS	Dynamotor unit		PM	
		Mounting FT-141		ST	368-1393
259		Pin plug	Receptacle plate assembly 165	U	268-1949
365		Snapslide stud; half hard brass	Part of mounting assembly FT-141	ST	268-1837
		Shock absorber	Part of mounting assembly FT-141	LM 100-PH-4	267-4280

27. LIST OF MANUFACTURERS

Key	*Name*	*Address*
AB	Allen-Bradley Co.	4124 Walnut St., Philadelphia, Pa.
AC	Aerovox Corp.	347 5th Ave., New York, N. Y.
AE	American Emblem Co.	Lincoln-Liberty Bldg., Philadelphia, Pa.
AH	Ace Mfg. Company	K St. and Erie Ave., Philadelphia, Pa.
BB	Bachmann Bros.	1420 E. Erie Ave., Philadelphia, Pa.
CC	Continental Carbon, Inc.	1390 Lorain Ave., Cleveland, Ohio
CD	Cornell-Dubilier Corp.	Hamilton Blvd., So. Plainfield, N. J.
EC	Electro-Chemical Engraving Co.	1100 Brook Ave., New York, N. Y.
ER	Erie Resistor Corp.	Erie, Pa.
FP	Fox Products Co.	4720 N. 18th St., Philadelphia, Pa.
FWS	F. W. Sickles Co.	Box 920, Springfield, Mass.
GE	General Electric Co.	1405 Locust St., Philadelphia, Pa.
GEC	Guardian Electric Co.	1621 W. Walnut St., Chicago, Ill.
HAS	H. A. Smith	Hopewell, N. J.
IRC	International Resistance Corp.	401 N. Broad St., Philadelphia, Pa.
LM	Lord Manufacturing Co.	1639 W. 12th St., Erie, Pa.
MW	Magnetic Winding Co.	16th and Butler Sts., Easton, Pa.
NC	National Co., Inc.	Malden, Mass.
OM	Oak Manufacturing Co.	1260 Claybourn Ave., Chicago, Ill.
P	Philco Radio & Television Corp.	C and Tioga Sts., Philadelphia, Pa.
PB	Pitney-Bowes Postage Meter Co.	1600 Arch St., Philadelphia, Pa.
PI	Poray, Inc.	3403 W. Grand Ave., Chicago, Ill.
PM	Pioneer Gen-E-Motor Corp.	5841 W. Dickens Ave., Chicago, Ill.
PR	Philadelphia Rust Proof Co.	3217 Frederick Ave., Philadelphia, Pa.
RC	Radio Condenser Co.	Thorne and Copewood Sts., Camden, N. J.
SM	Soreng-Manegold Co.	1901 Claybourn Ave., Chicago, Ill.
SC	Stackpole Carbon Co.	St. Marys, Pa.
SS	Sprague Specialties Co.	North Adams, Mass.
SAS	S. A. Simsack	1644 N. 2nd St., Philadelphia, Pa.
ST	Sinko Tool & Mfg. Co.	351 N. Crawford Ave., Chicago, Ill.
T	Teleradio Engineering Corp.	484 Broome St., New York, N. Y.
U	The Ucinite Co.	459 Watertown St., Newtonville, Mass.
WE	Weston Electric Instrument Co.	112 S. 16th St., Philadelphia, Pa.
WL	Ward-Leonard Co.	Bourse Bldg., Philadelphia, Pa.

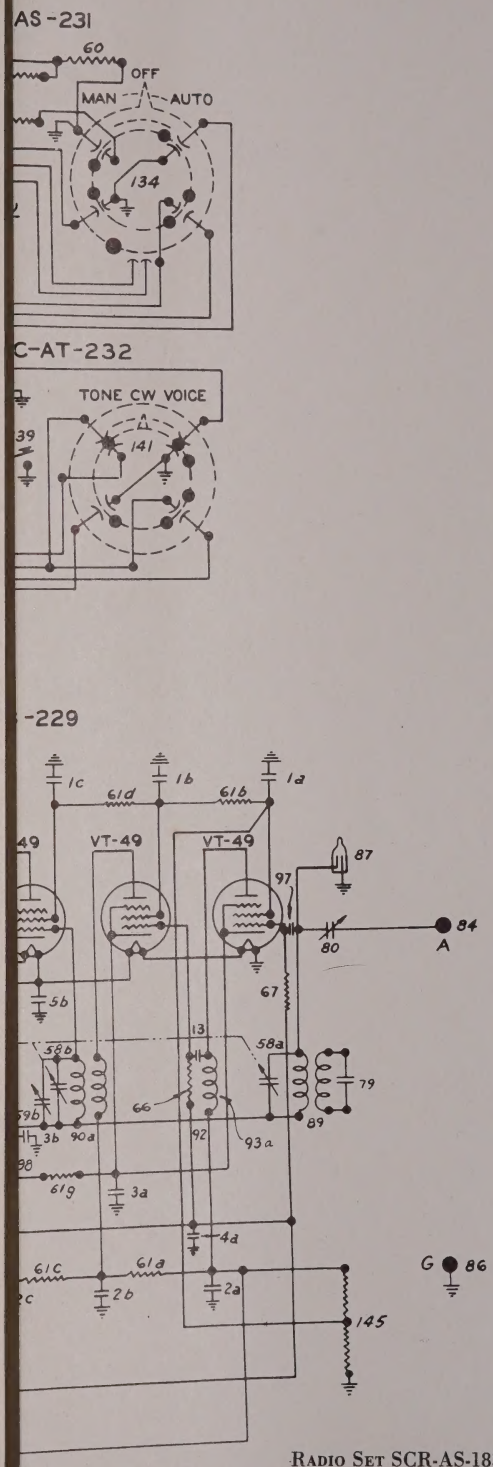


FIGURE 19–

RADIO SET SCR-AS-183, SCHEMATIC CIRCUIT DIAGRAM

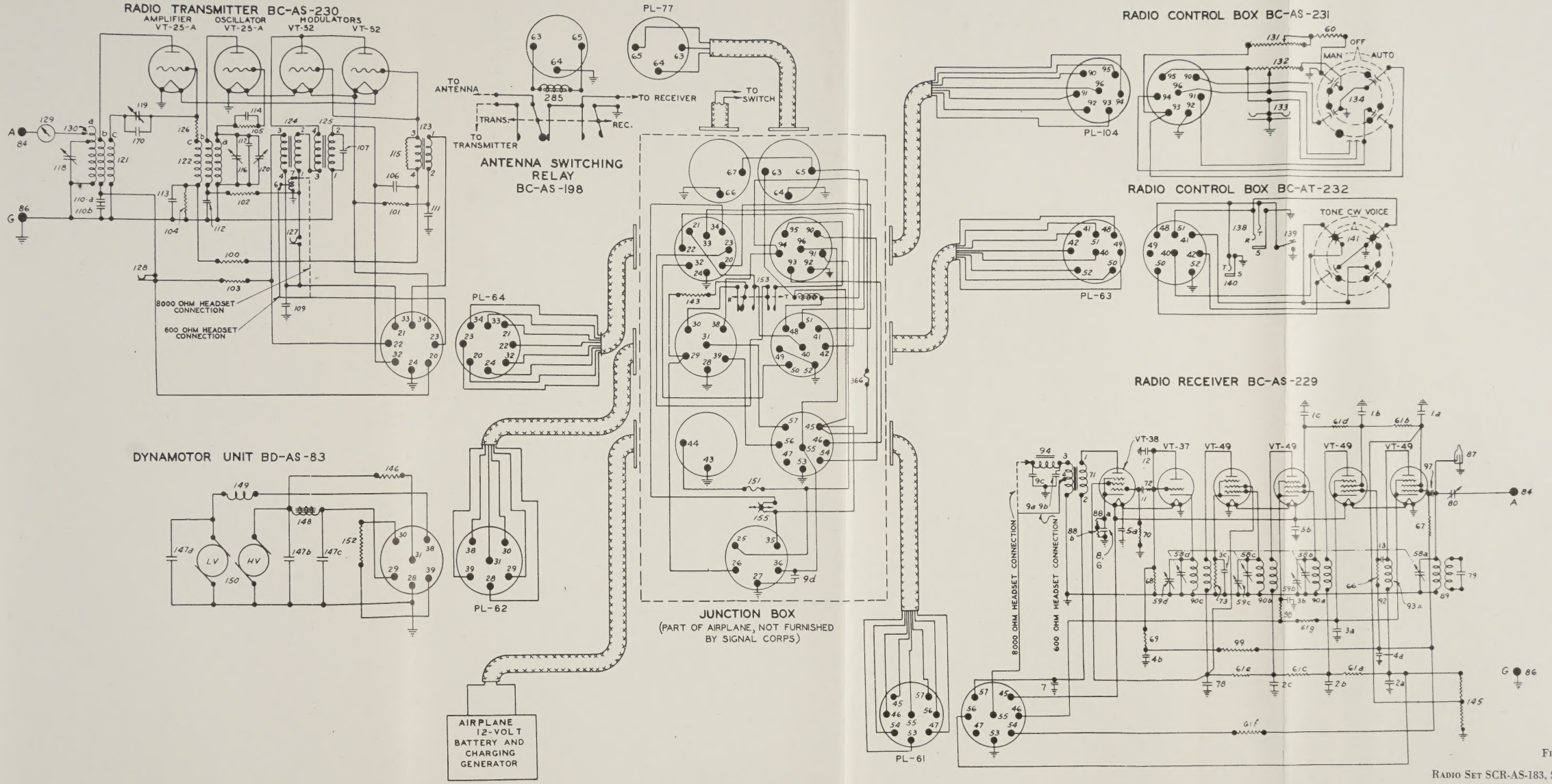
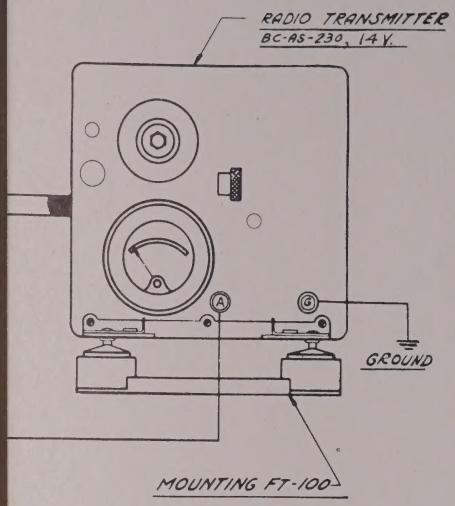


FIGURE 19–
RADIO SET SCR-AS-183, SCHEMATIC CIRCUIT DIAGRAM



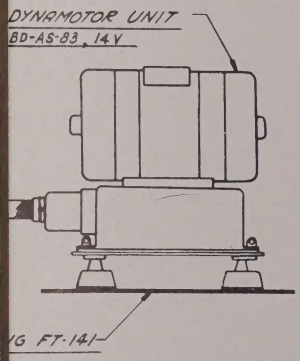


FIGURE 20—RADIO SET SCR-AS-183, CORDING DIAGRAM

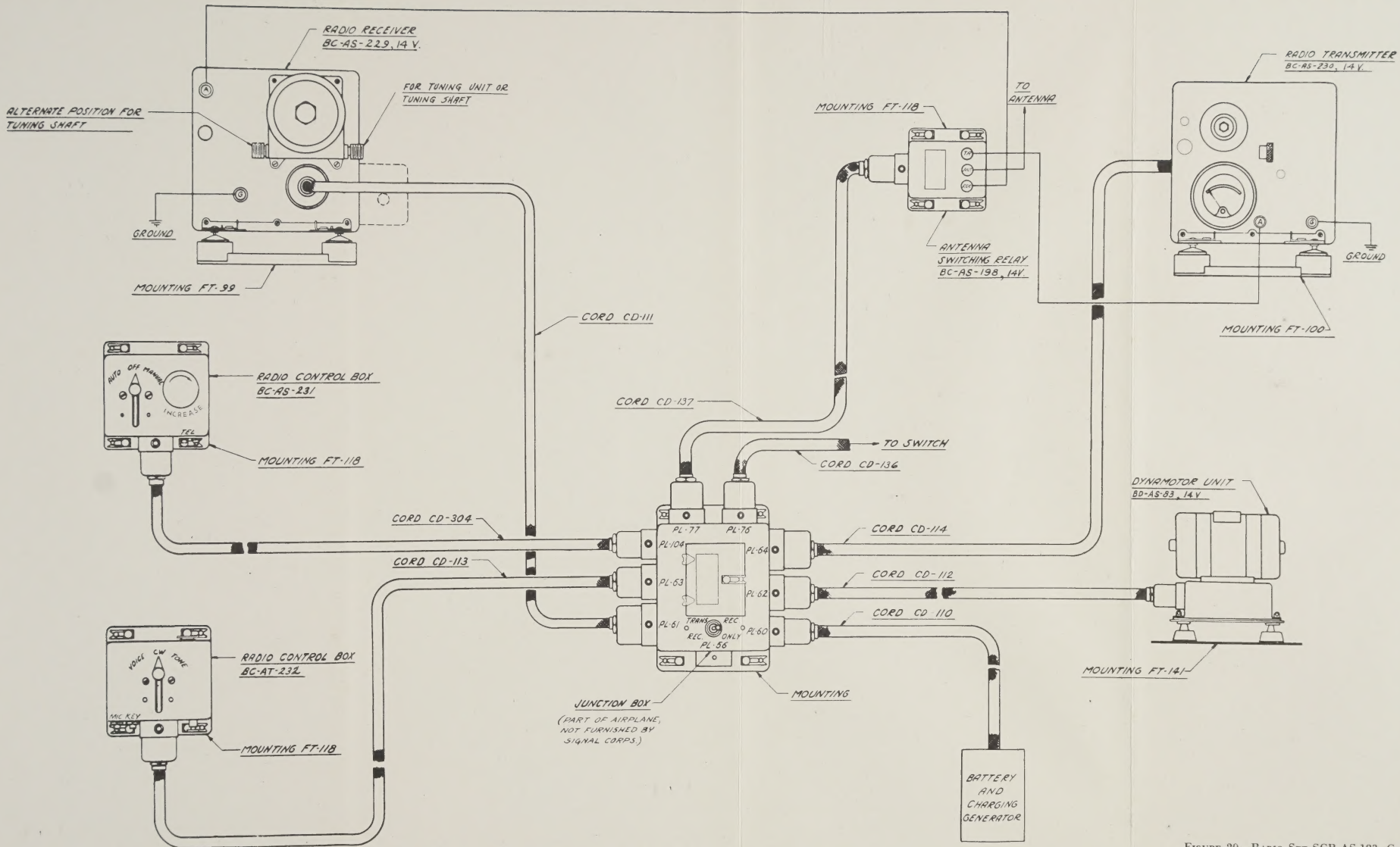


FIGURE 20—RADIO SET SCR-AS-183, CORDING DIAGRAM

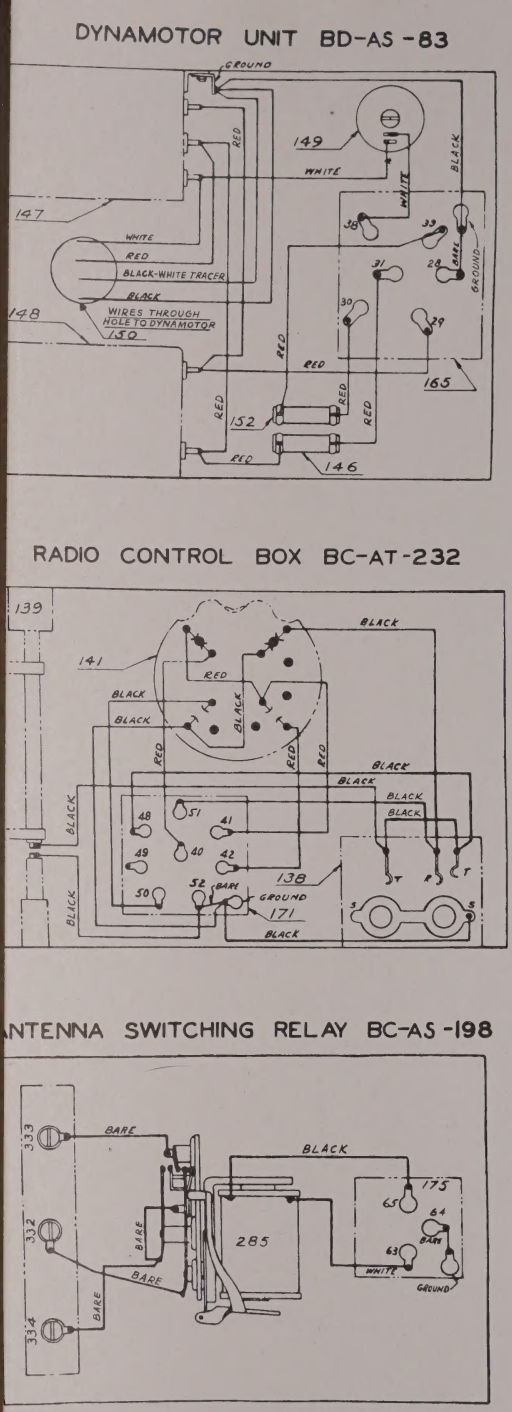
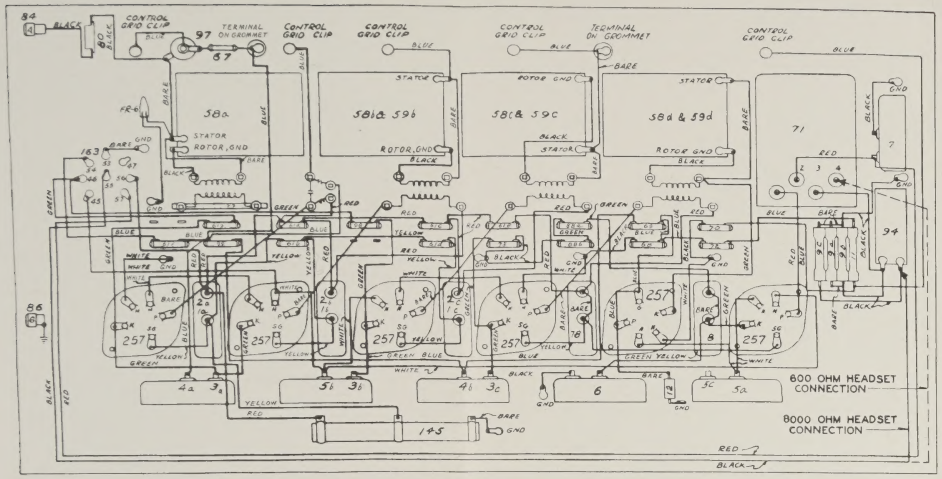
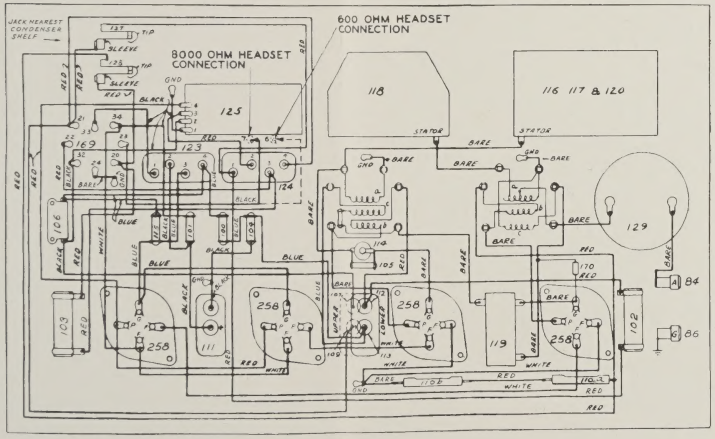


FIGURE 21—COMPONENTS OF RADIO SET SCR-AS-183, PRACTICAL WIRING DIAGRAM

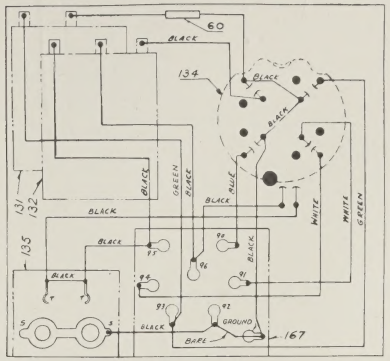
RADIO RECEIVER BC-AS-229

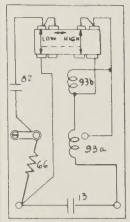


RADIO TRANSMITTER BC-AS-230

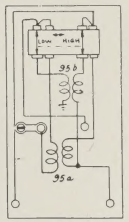


RADIO CONTROL BOX BC-AS-231

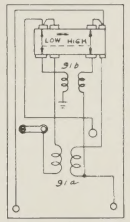




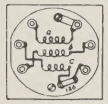
BAND PASS COIL ASSEMBLY 92 PART OF COIL UNITS C-439 & C-440



TUNED INPUT COIL ASSEMBLY 89 PART OF COIL UNITS C-439 & C-440

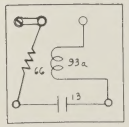


TUNED COUPLING COIL ASSEMBLIES 90a, 90b, 90c PART OF COIL UNITS C-439 & C-440

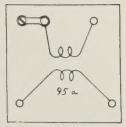


OSCILLATOR COIL ASSEMBLY FOR COIL SETS C-431, C-432, C-433 C-434 & C-435 SHIELDED

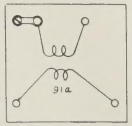
AMPLIFIER COIL ASSEMBLY FOR COIL SETS C-431, C-432, C-433 C-434 & C-435 UNSHIELDED



BAND PASS COIL ASSEMBLY 92 PART OF COIL UNITS C-436 & C-437

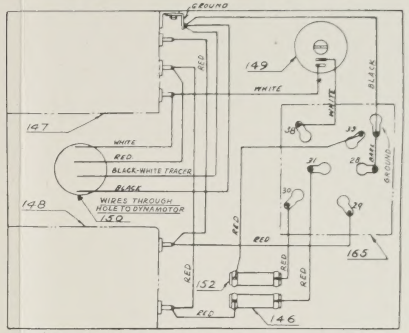


TUNED INPUT COIL ASSEMBLY 89 PART OF COIL UNITS C-436 & C-437

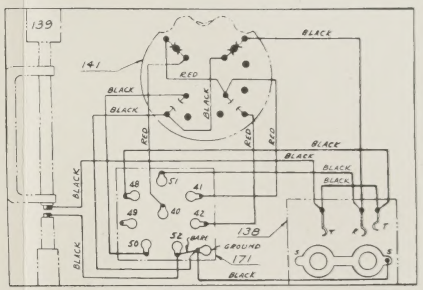


TUNED COUPLING COIL ASSEMBLIES 90a, 90b, 90c PART OF COIL UNITS C-436 & C-437

DYNAMOTOR UNIT BD-AS-83



RADIO CONTROL BOX BC-AT-232



ANTENNA SWITCHING RELAY BC-AS-198

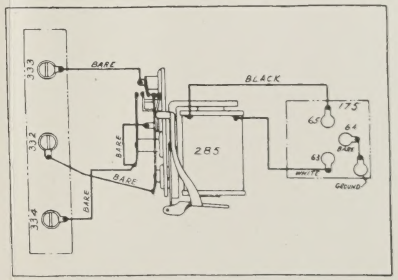


FIGURE 21—COMPONENTS OF RADIO SET SCR-AS-183, PRACTICAL WIRING DIAGRAM